

Marine Fish and Invertebrate Atlas: Summarizing Geographic Distribution and Population Indices in the Scotian Shelf and Bay of Fundy (1970-2020)

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MARINE FISH AND INVERTEBRATE ATLAS: GEOGRAPHIC DISTRIBUTION, POPULATION INDICES AND ENVIRONMENTAL PREFERENCES OF MARINE SPECIES IN THE SCOTIAN SHELF AND BAY OF FUNDY DERIVED FROM THE ANNUAL MARITIMES SUMMER SURVEY (1970-2020)

by

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ABSTRACT

169 Ricard, D., Gomez, C., Emberley, J. and Regnier-McKellar, C. 2021. Marine Fish and
170 Invertebrate Atlas: Geographic Distribution, Population Indices and Environmental Preferences
171 of marine species in the Scotian Shelf and Bay of Fundy derived from the annual Maritimes
172 Summer Survey (1970-2020). Can. Tech. Rep. Fish. Aquat. Sci. nnn: viii + 194 p.

173 The summer groundfish research vessel survey on the Scotian Shelf and in the Bay of
174 Fundy started in 1970 and was designed to measure the distribution and abundance of
175 major commercial fish species. Over time, additional information on non-commercial species
176 was collected, and allowed considerable insight into ecosystem function and structure, as
177 documented in many primary publications whose analyses used the survey data. The same
178 groundfish survey database has also been used to produce species status reports, atlases of
179 species distribution and remains an essential source of information for stock assessments in the
180 Maritimes Region of Fisheries and Oceans Canada. This report builds on previous work and
181 former atlases by updating a comprehensive suite of indices to assess population status and
182 environmental preferences of 104 species. For each species, trends in geographic distribution
183 and biomass or abundance were plotted. The spatial extent of distribution was plotted over
184 time to gauge how the area occupied has changed. The relationship between abundance or
185 biomass and spatial extent reflected whether the species distribution expands when abundance
186 or biomass increases. Length frequencies over time depicted any changes in mean size. The
187 plots of condition over time revealed whether individual fish are fatter or thinner than their long
188 term mean. Depth, temperature and salinity preferences were estimated to gauge the range
189 of suitable environmental parameters for each species. Finally, for each stratum, the slope
190 describing how local density varies with regional abundance was estimated. The reproducible
191 set of tools provided in this report constitutes a stepping stone to conduct other ecological
192 analyses using the summer groundfish research vessel survey data by fostering reproducibility
193 and transparency of ecological information collected and reported annually. Recognizing the
194 diversity of approaches for visualizing and mapping fish and invertebrates in the Scotian Shelf
195 bioregion, we recommend the development of a regional community of practice to compare and
196 evaluate approaches for mapping, interpolating and/or modelling fish and invertebrates so future
197 publications and advice can lead to more comparable work and consistent science advice to
198 support processes such as marine spatial planning.

RÉSUMÉ

200 Ricard, D., Gomez, C., Emberley, J. and Regnier-McKellar, C. 2021. Marine Fish and
201 Invertebrate Atlas: Geographic Distribution, Population Indices and Environmental Preferences
202 of marine species in the Scotian Shelf and Bay of Fundy derived from the annual Maritimes
203 Summer Survey (1970-2020). Can. Tech. Rep. Fish. Aquat. Sci. nnn: viii + 194 p.

204 Le relevé estival par navires de recherche sur le poisson de fond sur le plateau néo-écossais
205 et dans la baie de Fundy a débuté en 1970 et visait à mesurer la répartition et l'abondance
206 des principales espèces de poissons commerciales. Au fil du temps, des informations
207 supplémentaires sur les espèces non commerciales ont été recueillies et ont permis de mieux
208 comprendre la fonction et la structure de l'écosystème, comme le montrent de nombreuses
209 publications primaires dont les analyses ont utilisé les données d'enquête. La même base
210 de données sur les relevés du poisson de fond a également été utilisée pour produire des
211 rapports sur la situation des espèces, des atlas de la répartition des espèces et demeure une
212 source essentielle d'information pour les évaluations des stocks dans la région des Maritimes
213 de Pêches et Océans Canada. Ce rapport s'appuie sur des travaux antérieurs et d'anciens
214 atlas en mettant à jour une série complète d'indices pour évaluer l'état de la population et les
215 préférences environnementales de 104 espèces. Pour chaque espèce, les tendances de la
216 répartition géographique et de la biomasse ou de l'abondance ont été tracées. L'étendue spatiale
217 de la distribution a été tracée au fil du temps pour évaluer comment la zone occupée a changé.
218 La relation entre l'abondance ou la biomasse et l'étendue spatiale indique si la répartition
219 des espèces augmente lorsque l'abondance ou la biomasse augmente. Les fréquences de
220 longueur au fil du temps représentaient tout changement dans la taille moyenne. Les graphiques
221 de l'état au fil du temps ont révélé si les poissons individuels sont plus gros ou plus minces
222 que leur moyenne à long terme. Les préférences en matière de profondeur, de température
223 et de salinité ont été estimées pour évaluer la gamme de paramètres environnementaux
224 appropriés pour chaque espèce. Enfin, pour chaque strate, la pente décrivant comment la
225 densité locale varie avec l'abondance régionale a été estimée. L'ensemble d'outils reproductibles
226 fournis dans ce rapport constitue un tremplin pour effectuer d'autres analyses écologiques
227 à l'aide des données du relevé estival des navires de recherche sur les poissons de fond
228 en favorisant la reproductibilité et la transparence de l'information écologique recueillie et
229 rapportée annuellement. Reconnaissant la diversité des approches de visualisation et de
230 cartographie des poissons et des invertébrés dans la biorégion du plateau néo-écossais, nous
231 recommandons le développement d'une communauté de pratique régionale pour comparer et
232 évaluer les approches de cartographie, d'interpolation et / ou de modélisation des poissons
233 et des invertébrés afin conduire à des travaux plus comparables et à des avis scientifiques
234 cohérents pour soutenir des processus tels que la planification de l'espace marin.

235

1 Introduction

236 The summer (July-August) groundfish research vessel survey on the Scotian Shelf and in the
237 Bay of Fundy was started in 1970 by Fisheries and Oceans Canada Maritimes Region. The
238 survey was originally designed to measure the distribution and abundance of major commercial
239 fish species. Over time, information on non-commercial species was also collected. The
240 groundfish survey database storing the information collected during the annual survey provides
241 the main source of fisheries-independent information for marine species in the region. This
242 information is routinely used to support stock assessments, to produce species status reports
243 and has been previously used to publish atlases of species distribution.

244 The current document is an update of an earlier report (Ricard and Shackell 2013) that built
245 on former atlases by updating a comprehensive suite of derived indices for 104 species to
246 assess population status and, when feasible, environmental preferences. The information
247 collected during the survey is stored in a relational database management system archived
248 at Fisheries and Oceans Canada Maritimes Region which contains detailed information about
249 the sampling locations and the associated catch. Tow-level survey data is also publicly available
250 from the Ocean Biogeographic Information System (DFO 2016) and from the Open data portal
251 supported by the federal government (DFO 2021). The present atlas builds upon the work done
252 by Fisheries and Oceans colleagues from the northern Gulf of St. Lawrence (Bourdages and
253 Ouellet 2012), southern Gulf of St. Lawrence (Benoît et al. 2003) and on earlier work in the
254 Scotian Shelf (Simon and Comeau 1994; Horsman and Shackell 2009).

255 To facilitate updates and foster collaboration on the analyses of the survey data, the computer
256 code necessary to extract the data, to perform the analyses presented herein, and to reproduce
257 and update the current document is made available in a git repository (Ricard and Gomez 2021).

258 The survey area covers three major Northwest Atlantic Fisheries Organization (NAFO) zones
259 that divide the Scotian Shelf into the colder east 4V and 4W (strata 440-466) and warmer
260 west 4X (strata 470-495). For each species, temporal trends in geographic distribution and,
261 when possible, biomass are plotted. Some caution is required in interpreting the results
262 obtained for several taxa due to low sample size as explained later in the text. A full ecological
263 interpretation of trends is beyond the scope of this report. Other documents stemming from peer-
264 reviewed scientific processes under the auspices of the [Canadian Science Advisory Secretariat](#)
265 (CSAS) provide further descriptions of spatio-temporal trends in different indicators and put the
266 information collected during the summer groundfish research vessel survey in a more focused
267 context (see for example Clark and Emberley (2011)).

268

2 Methods

269 2.1 Survey Description

270 The survey is conducted annually in July-August and covers the Scotian Shelf and the Bay of
271 Fundy (Figure 2). It normally involves two separate two-week trips on board an offshore fisheries
272 vessel from the Canadian Coast Guard.

273 A number of changes in fishing gear type and vessels used occurred since the onset of sampling
274 activities (Clark and Emberley 2011). Comparative fishing experiments were conducted when
275 those changes in survey platforms took place (Koeller and Smith 1983; Fanning 1984; Fowler
276 and Showell 2009). The A.T. Cameron using a Yankee 36 trawl was the primary survey vessel
277 from 1970 to 1981. The vessel that was then built to replace the A.T. Cameron to conduct trawl
278 surveys (CCGS Alfred Needler) was not yet operational and the Lady Hammond was used
279 to bridge the gap between the A.T. Cameron and the CCGS Alfred Needler. A change to the
280 Western IIA trawl also took place after A.T. Cameron was retired. The CCGS Alfred Needler
281 entered service for the 1983 summer survey using a Western IIA trawl. It has been the main
282 survey platform since. The CCGS Alfred Needler suffered a fire in 2003 and the CCGS Teleost
283 was used instead. In 2007, 2008 and 2018 the CCGS Alfred Needler was not available and
284 the survey was conducted on the CCGS Teleost in 2007 and 2018, and on the CCGS Wilfred
285 Templeman in 2008. A timeline of the survey platforms can be found in Figure 1.

286 In 2018, because of the unavailability of the CCGS Alfred Needler, only a partial survey coverage
287 was achieved on CCGS Teleost and most of the strata in NAFO Division 4VW were not sampled.

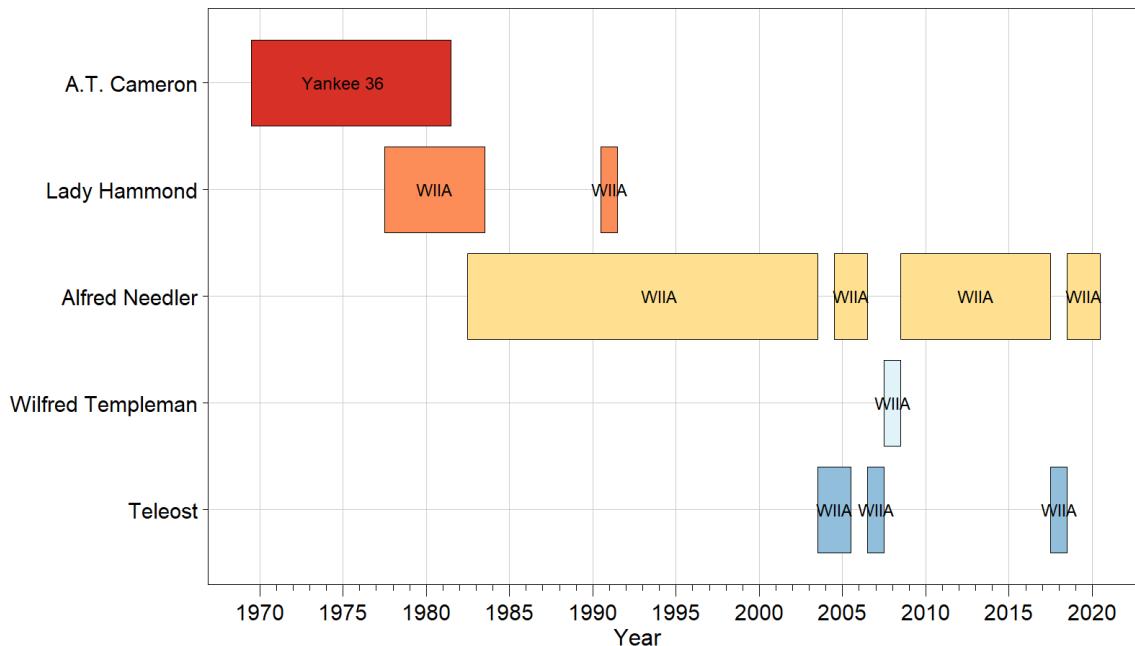


Figure 1. Timeline of survey platforms used in the Maritimes Region summer survey. The x axis denotes the timespan of the survey. The y axis identifies the vessel on which survey sets were conducted. The type of fishing gear deployed is overlaid on the polygon representing the time window when each vessel was used (WIIA is the Western IIA trawl).

288 2.2 Sampling Design

289 The summer survey covers divisions 4V, 4W and 4X of the Northwest Atlantic Fisheries
290 Organization (NAFO) which includes the Scotian Shelf and the Bay of Fundy. The eastern limit of
291 the survey is the Laurentian Channel and the western limit is the Fundian Channel (Figure 2).

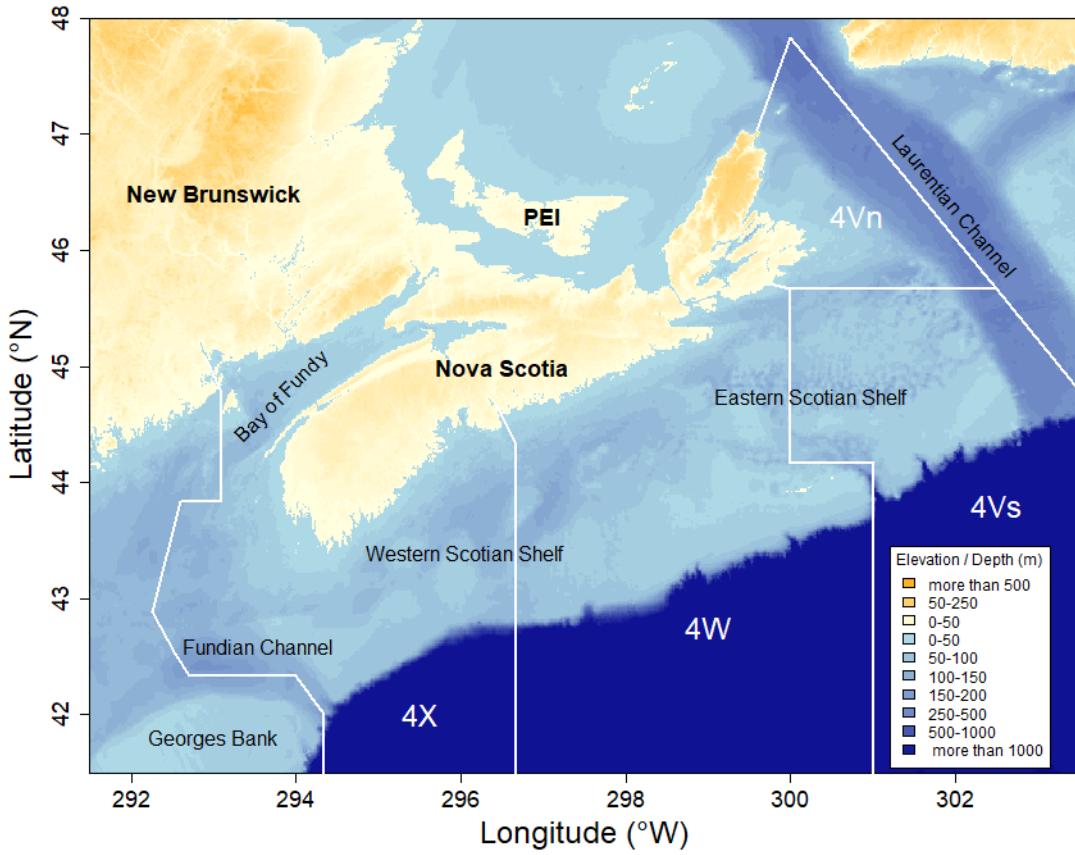


Figure 2. Map of the Scotian Shelf and Bay of Fundy where the DFO Maritimes summer survey takes place. The bathymetry presented here is the 15 arc-second gridded data set from the General Bathymetric Chart of the Oceans ([GEBCO](#)). Geographical locations of interest and the boundaries of relevant NAFO Divisions are also shown on the map.

292 The survey follows a stratified random design (Doubleday and Rivard 1981; Lohr 1999)
 293 (Figure 3). The number of tows conducted in each stratum is approximately proportional to the
 294 surface area of the stratum. The targeted area covered by the survey has remained constant
 295 since its inception, with the exception of additional deeper strata that were only sampled a few
 296 times since 2000. Because the sampling of the deeper strata is opportunistic and irregular, the
 297 analyses presented herein only include strata 440 to 495 which cover NAFO Divisions 4V, 4W
 298 and 4X (Figure 3 and Table 1).

299 The basic sampling unit of the survey is a 30-minute fishing tow conducted at a speed of 3.5
 300 knots. This yields a distance towed of 1.75 nautical miles.

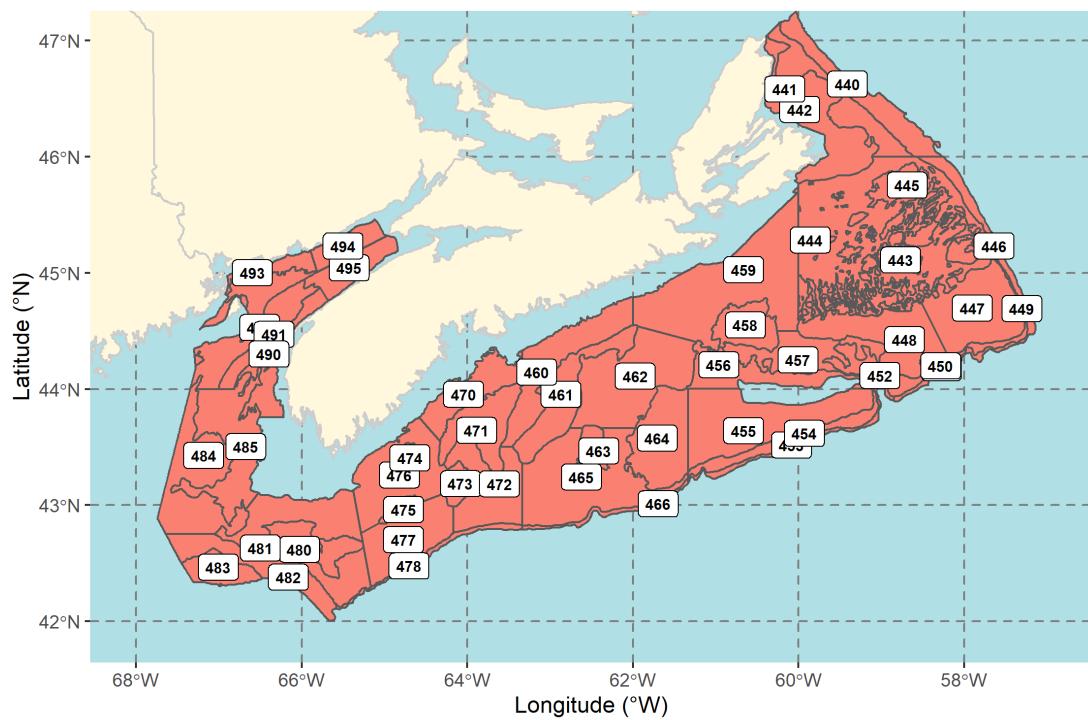


Figure 3. Map of the summer survey strata 440 to 495.

Table 1. Summer survey strata details. The strata used in the analyses are presented separately for NAFO Divisions 4Vn, 4VsW and 4X. For each stratum, the depth range in fathoms and the surface area in square kilometers are reported.

NAFO Div.	Stratum	Depth range (fathom)	Area (km²)
4Vn	440	101-200	924
	441	51-100	1000
	442	11-49	1437
4VsW	443	11-49	1318
	444	51-100	3925
	445	101-200	1023
	446	101-200	491
	447	11-49	1616
	448	11-49	1449
	449	51-100	144
	450	51-100	383
	451	101-200	147
	452	101-200	345
	453	101-200	259
	454	51-100	499
	455	11-49	2122
	456	11-49	955
	457	51-100	811
	458	11-49	658
	459	11-200	3148
	460	51-100	1344
	461	101-200	1154
	462	51-100	2116
	463	11-49	302
	464	11-50	1297
	465	51-100	2383
	466	101-200	226

NAFO Div.	Stratum	Depth range (fathom)	Area (km ²)
4X	470	51-100	920
	471	101-200	1004
	472	51-100	1249
	473	11-49	265
	474	11-49	161
	475	11-49	156
	476	51-100	1478
	477	51-100	1232
	478	101-200	233
	480	11-49	655
	481	51-100	1875
	482	101-200	1042
	483	101-200	532
	484	101-200	2264
	485	51-100	1582
	490	11-49	601
	491	51-100	687
	492	51-100	1086
	493	11-49	533
	494	11-49	417
	495	11-49	584

301 After each tow the catch is sorted by species and weighed. Each fish caught is then measured,
 302 and further sampling of individual fish weight, maturity status and age are performed for different
 303 length classes. When catches exceed 300 individuals, a random sub-sample is used to obtain
 304 the length and weight measurements.

305 2.3 Taxonomic Levels

306 Fish species caught during the surveys are identified by trained scientific personnel and their
 307 scientific name is determined. An internal species code used in the relational database is
 308 reported for each species (Losier and Waite 1989).

309 By its nature as a bottom trawl, the fishing gear used in the survey catches certain species
 310 better than others. To ensure that meaningful ecological information can be extracted from
 311 catch samples, we report the catch records for the subset of species that are caught reliably
 312 by the gear. To appear in this atlas, a species must have had a minimum of 10 observations over
 313 the duration of the survey activities. While both catch abundance and weight are recorded, the
 314 weight of species that appear at low abundances is often recorded as zero in the earlier parts of
 315 the survey when scales of appropriate precision were not available.

316 We divided the species caught into five categories based on 1) their taxonomic classification,

317 2) the number of recorded observations, and 3) their period of valid identification (Table 2).
318 Category "LF", for "long frequent", was assigned to species that have more than 1000 records
319 since 1970 and have been consistently identified since the onset of the survey. Category
320 "LI", for "long intermediate", was assigned to species that had between 1000 and 200 catch
321 records. Rare and elusive species (those with less than 200 catch records over the duration
322 of the survey) are also reported but to a lower level of analytical details (Category "LR", for
323 "long rare"). Category "SF", for "short frequent", was assigned to invertebrate species that were
324 consistently sampled only since 1999 (Tremblay M. J. 2007). And category "SR", for "short rare"
325 for invertebrate species consistently sampled only since 1999 and with less than 200 catch
326 records. To ensure concordance with authoritative taxonomic information, the AphiaID from the
327 World Register of Marine Species (Appeltans et al. 2012) is included for the different species
328 presented in this document (Table 3) .

Table 2. Taxonomic levels used to determine the analytical treatment for each species.

Category	Name	Description
L	long - consistently identified since the onset of the survey in 1970	
LF	long frequent	species that have more than 1000 catch records
LI	long intermediate	species that had between 1000 and 200 catch records
LR	long rare	species with less than 200 catch records
S	short - invertebrate	species that were consistently sampled only since 1999
SF	short frequent	species with more than 200 catch records
SR	short rare	species with less than 200 catch records

Table 3. List of species included in the Atlas. For each taxonomic order and class, each species is listed in the table, its taxonomic family and scientific name is provided, along with its French and English common names, the species code used in the survey database, its AphiaID with a link to the World Registry of Marine Species, its number of catch records in the survey database and its classification category as defined in section 2.3.

	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Actinopterygii								
<i>Anguilliformes</i>								
	Nemichthyidae	<i>Nemichthys scolopaceus</i>	Slender snipe eel	Avocette ruban	604	126306	28	LR
<i>Argentiniformes</i>								
	Argentinidae	<i>Argentina silus</i>	Greater argentine	Grande argentine	160	126715	963	LI
<i>Aulopiformes</i>								
	Chlorophthalmidae	<i>Chlorophthalmus agassizi</i>	Shortnose greeneye	Éperlan du large	156	126336	78	LR
		<i>Parasudis truculenta</i>	Longnose greeneye	Oeil-vert à long nez	149	158868	45	LR
	Paralepididae	<i>Arctozenus risso</i>	White barracudina	Lussion blanc	712	126352	196	LR
<i>Beloniformes</i>								
	Scomberesocidae	<i>Scomberesox saurus</i>	Atlantic saury	Balaou atlantique	720	126392	37	LR
<i>Clupeiformes</i>								
	Clupeidae	<i>Alosa pseudoharengus</i>	Alewife	Gaspareau	62	158669	977	LI
		<i>Alosa sapidissima</i>	American shad	Alose savoureuse	61	158670	468	LI
		<i>Clupea harengus</i>	Atlantic herring	Hareng de l'Atlantique	60	126417	3487	LF
<i>Gadiformes</i>								
	Gadidae	<i>Gadus morhua</i>	Atlantic cod	Morue franche	10	126436	5451	LF
		<i>Melanogrammus aeglefinus</i>	Haddock	Aiglefin	11	126437	5827	LF
		<i>Microgadus tomcod</i>	Atlantic tomcod	Poulamon atlantique	17	158928	44	LR
		<i>Pollachius virens</i>	Pollock	Goberge	16	126441	2787	LF
	Lotidae	<i>Brosme brosme</i>	Cusk	Brosme	15	126447	688	LI

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Perciformes	Macrouridae		<i>Enchelyopus cimbricus</i>	Fourbeard rockling	Motelle à quatre barbillons	114	126450	693	LI
			<i>Coryphaenoides rupestris</i>	Roundnose grenadier	Grenadier de roche	414	158960	17	LR
			<i>Nezumia bairdii</i>	Marlin-spike grenadier	Grenadier du Grand Banc	410	183289	529	LI
			<i>Trachyrincus murrayi</i>	Roughnose grenadier	Grenadier-scie	412	126481	18	LR
	Merlucciidae		<i>Merluccius albidus</i>	Offshore silver hake	Merlu argenté du large	19	158748	161	LR
			<i>Merluccius bilinearis</i>	Silver hake	Merlu argenté	14	158962	4936	LF
	Phycidae		<i>Phycis chesteri</i>	Longfin hake	Merluche à longues nageoires	112	158988	784	LI
			<i>Urophycis chuss</i>	Red hake	Merluche écureuil	13	126503	2195	LF
			<i>Urophycis tenuis</i>	White hake	Merluche blanche	12	126504	3524	LF
<i>Lophiiformes</i>	Lophiidae	<i>Lophius americanus</i>	Monkfish	Baudroie d'Amérique	400	159184	1970	LF	
	Ogcocephalidae	<i>Dibranchus atlanticus</i>	Atlantic batfish	Malthe atlantique	742	126558	18	LR	
	Myctophidae	<i>Myctophidae</i>	Lanternfishes	Poissons-lanternes	150	125498	160	LR	
<i>Osmeriformes</i>	Osmeridae		<i>Mallotus villosus</i>	Capelin	Capelan	64	126735	540	LI
			<i>Osmerus mordax</i>	Rainbow smelt	Éperlan arc-en-ciel	63	126737	59	LR
	Ammodytidae	<i>Ammodytes dubius</i>	Sand lance	Lançon	610	151520	1283	LI	
<i>Anarhichadidae</i>			<i>Anarhichas denticulatus</i>	Northern wolffish	Loup à tête large	52	126757	17	LR
			<i>Anarhichas lupus</i>	Atlantic wolffish	Loup atlantique	50	126758	1572	LF

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
			<i>Anarhichas minor</i>	Spotted wolffish	Loup tacheté	51	126759	20	LR
		Callionymidae	<i>Foetorepus agassizii</i>	Spotfin dragonet	Dragonnet tacheté	637	276339	20	LR
		Cryptacanthodidae	<i>Cryptacanthodes maculatus</i>	Wrymouth	Terrassier tacheté	630	159675	120	LR
		Labridae	<i>Tautogolabrus adspersus</i>	Cunner	Tanche-tautogue	122	159785	82	LR
		Pholidae	<i>Pholis gunnellus</i>	Rock gunnel	Sigouine de roche	621	126996	21	LR
		Scombridae	<i>Scomber scombrus</i>	Atlantic mackerel	Maquereau commun	70	127023	696	LI
		Stichaeidae	<i>Eumesogrammus praecisus</i>	Fourline snakeblenny	Quatre-lignes atlantique	626	159817	40	LR
			<i>Leptoclinus maculatus</i>	Daubed shanny	Lompénie tachetée	623	127072	443	LI
			<i>Lumpenus lampretaeformis</i>	Snakeblenny	Lompénie-serpent	622	154675	423	LI
			<i>Ulvaria subbifurcata</i>	Radiated shanny	Ulvaire deux-lignes	625	159821	145	LR
		Stromateidae	<i>Peprilus triacanthus</i>	Atlantic butterfish	Stromaté fossette	701	159828	487	LI
		Zoarcidae	<i>Lycenchelys verrillii</i>	Wolf eelpout	Lycode à tête longue	603	159258	40	LR
			<i>Lycodes lavalaei</i>	Newfoundland eelpout	Lycode du Labrador	620	127107	72	LR
			<i>Lycodes reticulatus</i>	Arctic eelpout	Lycode arctique	641	127112	70	LR
			<i>Lycodes terraenovae</i>	Newfoundland eelpout	Lycode du Labrador	619	127117	64	LR
			<i>Lycodes vahlii</i>	Vahl's eelpout	Lycode à carreaux	647	127118	565	LI
			<i>Melanostigma atlanticum</i>	Atlantic soft pout	Molasse atlantique	646	127120	43	LR
			<i>Zoarces americanus</i>	Ocean pout	Loquette d'Amérique	640	159267	1478	LF
<i>Pleuronectiformes</i>		Cynoglossidae	<i>Syphurus diomedeanus</i>	Spottedfin tonguefish	Langue fil noir	816	159358	24	LR

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
		Paralichthyidae	<i>Citharichthys arctifrons</i>	Gulf Stream flounder	Plie du Gulf Stream	44	158791	382	LI
			<i>Hippoglossina oblonga</i>	Fourspot flounder	Cardeau à quatre ocelles	142	158833	76	LR
		Pleuronectidae	<i>Glyptocephalus cynoglossus</i>	Witch flounder	Plie grise	41	127136	4301	LF
			<i>Hippoglossoides platessoides</i>	American plaice	Plie canadienne	40	127137	6023	LF
			<i>Hippoglossus hippoglossus</i>	Atlantic halibut	Flétan de l'Atlantique	30	127138	1634	LF
			<i>Limanda ferruginea</i>	Yellowtail flounder	Limande à queue jaune	42	158879	3233	LF
			<i>Pseudopleuronectes americanus</i>	Winter flounder	Limande-plie rouge	43	158885	1632	LF
			<i>Reinhardtius hippoglossoides</i>	Greenland halibut	Flétan noir	31	127144	736	LI
		Scophthalmidae	<i>Scophthalmus aquosus</i>	Windowpane flounder	Turbot de sable	143	158907	115	LR
Scorpaeniformes	Agonidae		<i>Agonidae</i>	Alligatorfishes	Poissons-alligator	351	125588	43	LR
			<i>Aspidophoroides monopterygius</i>	Alligatorfish	Poisson-alligator atlantique	340	159459	1029	LF
			<i>Leptagonus decagonus</i>	Atlantic poacher	Agone atlantique	350	127191	266	LI
			<i>Ulcina olrikii</i>	Arctic alligatorfish	Poisson-alligator arctique	341	274356	13	LR
	Cottidae		<i>Artediellus atlanticus</i>	Atlantic hookear sculpin	Hameçon atlantique	880	127193	258	LI
			<i>Artediellus uncinatus</i>	Arctic hookear sculpin	Hameçon neigeux	306	127195	306	LI

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Perciformes	Triglidae		<i>Icelus spatula</i>	Spatulate sculpin	lcèle spatulée	314	127200	40	LR
			<i>Myoxocephalus aenaeus</i>	Grubby	Chabosseau bronzé	303	159519	40	LR
			<i>Myoxocephalus octodecemspinosus</i>	Longhorn sculpin	Chabosseau à dix-huit épines	300	159520	3292	LF
			<i>Myoxocephalus scorpius</i>	Shorthorn sculpin	Chabosseau à épines courtes	301	127203	131	LR
			<i>Triglops murrayi</i>	Moustache sculpin	Faux-trigle armé	304	127205	1182	LF
	Cyclopteridae		<i>Cyclopterus lumpus</i>	Lumpfish	Lompe	501	127214	216	LI
			<i>Eumicrotremus spinosus</i>	Atlantic spiny lumpucker	Petite poule de mer atlantique	502	127217	226	LI
	Hemitripteridae		<i>Hemitripterus americanus</i>	Sea raven	Hémithriptère atlantique	320	159518	2126	LF
	Liparidae		<i>Careproctus reinhardtii</i>	Sea tadpole	Petite limace de mer	520	127212	18	LR
			<i>Liparis atlanticus</i>	Atlantic seasnail	Limace atlantique	503	159524	34	LR
			<i>Liparis fabricii</i>	Gelatinous snailfish	Limace gélatineuse	505	127218	27	LR
			<i>Liparis gibbus</i>	Variegated snailfish	Limace marbée	512	159526	41	LR
Stomiiformes	Psychrolutidae		<i>Cottunculus microps</i>	Polar sculpin	Cotte polaire	307	127235	29	LR
	Sebastidae		<i>Helicolenus dactylopterus</i>	Blackbelly rosefish	Sébaste chèvre	123	127251	610	LI
			<i>Sebastes</i>	Atlantic redfishes	Sébastes de l'Atlantique	23	126175	4152	LF
	Sternopychidae		<i>Maurolicus muelleri</i>	Silvery lightfish	Brossé améthyste	158	127312	52	LR
			<i>Sternopychidae</i>	Hatchetfishes	Haches d'argent	741	125603	21	LR
	Stomiidae		<i>Stomias boa</i>	Boa dragonfish	Dragon-boa	159	127374	20	LR
<i>Zeiformes</i>									

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
		Zeidae	<i>Zenopsis conchifer</i>	Silvery John dory	Saint Pierre argenté	704	127426	39	LR
Cephalopoda									
<i>Myopsida</i>									
		Loliginidae	<i>Doryteuthis pealeii</i>	Longfin inshore squid	Calmar totam	4512	574541	96	LR
<i>Oegopsida</i>									
		Ommastrephidae	<i>Illex illecebrosus</i>	Northern shortfin squid	Encornet rouge nordique	4511	153087	4836	LF
Elasmobranchii									
<i>Rajiformes</i>									
		Rajidae	<i>Amblyraja radiata</i>	Thorny skate	Raie épineuse	201	105865	3937	LF
			<i>Dipturus laevis</i>	Barndoor skate	Grande raie	200	158548	246	LI
			<i>Leucoraja erinacea</i>	Little skate	Raie hérisson	203	158551	712	LI
			<i>Leucoraja ocellata</i>	Winter skate	Raie tachetée	204	158553	1180	LF
			<i>Malacoraja senta</i>	Smooth skate	Raie lisse	202	158554	1773	LF
<i>Squaliformes</i>									
		Etmopteridae	<i>Centroscyllium fabricii</i>	Black dogfish	Aiguillat noir	221	105906	31	LR
		Squalidae	<i>Squalus acanthias</i>	Piked dogfish	Aiguillat commun	220	105923	1985	LF
Malacostraca									
<i>Decapoda</i>									
		Cancridae	<i>Cancer borealis</i>	Jonah crab	Tourteau jona	2511	158056	1387	SF
			<i>Cancer irroratus</i>	Atlantic rock crab	Tourteau poïnclos	2513	158057	788	SF
		Geryonidae	<i>Chaceon quinquedens</i>	Red deepsea crab	Crabe rouge	2532	158407	33	SR
		Lithodidae	<i>Lithodes maja</i>	Atlantic king crab	Crabe épineux du nord	2523	107205	531	SF
		Nephropidae	<i>Homarus americanus</i>	American lobster	Homard américain	2550	156134	1623	SF

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Oregoniidae			<i>Chionoecetes opilio</i>	Queen crab	Crabe des neiges	2526	107315	1546	SF
			<i>Hyas araneus</i>	Great spider crab	Crabe lyre araignée	2527	107322	625	SF
			<i>Hyas coarctatus</i>	Arctic lyre crab	Crabe Hyas coarctatus	2521	107323	711	SF
		Pandalidae	<i>Pandalus borealis</i>	Northern prawn	Crevette nordique	2211	107649	718	SF
Myxini									
<i>Myxiniformes</i>									
		Myxinidae	<i>Myxine glutinosa</i>	Atlantic hagfish	Myxine du nord	241	101170	804	LI
Petromyzonti									
<i>Petromyzontiformes</i>									
		Petromyzontidae	<i>Petromyzon marinus</i>	Sea lamprey	Lamproie marine	240	101174	16	LR

329 **2.4 Analyses**

330 The Oracle relational database where all survey data are stored and archived is accessible from
331 the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Queries written in Structured
332 Query Language (SQL) are used to extract the data from the production server and to create the
333 data products used in all subsequent analyses. Catch records classified as "valid" (i.e. coming
334 from a representative tow without damage to the net) are used in the current analyses. To make
335 the available samples comparable, catch number and weight for each species was standardized
336 for the distance towed.

337 All data processing and analyses were conducted using the R software (R Core Team 2020)
338 using packages gstat (Pebesma 2004), PBSmapping (Schnute et al. 2019), RODBC (Ripley
339 and Lapsley 2019), spatstat (Baddeley 2015), maptools (Bivand and Lewin-Koh 2020), rgeos
340 (Bivand and Rundel 2020), classInt(Bivand 2020), RColorBrewer(Neuwirth 2014), MASS (Ripley
341 et al. 2020), worms (Holstein 2018), and tidyverse (Wickham 2019). The present document is
342 rendered as a Technical Report using the csasdown R package developed and maintained by
343 Fisheries and Oceans Canada scientists (Anderson et al. 2021).

344 **2.4.1 Geographic distribution of catches**

345 Spatial interpolation of catch biomass (kg/tow) was done using a weighting inversely proportional
346 to the distance (inverse-distance weighted, IDW), using function "idw" of the spatstat R package
347 (Baddeley 2015). The IDW method was used with a power parameter value of 10.

348 **2.4.2 Biomass indices**

349 For each species, stratified random estimates of catch biomass (Smith 1996) were computed
350 for each year. Yearly estimates of the standard error were also computed. In years where some
351 strata were not sampled, the stratified estimate is calculated ignoring the missed strata. This
352 implicitly assumes that the captures in the missed strata were the same as the overall mean. If a
353 species does not follow this assumption in the missed strata the estimate will be biased. As such,
354 the values presented herein should be treated with further analytical detail to ascertain that the
355 estimate is unbiased.

356 **2.4.3 Distribution indices**

357 For each Category L, I and S fish species, the minimum area required to account for 75% and
358 95% of the total biomass were computed (D75% and D95%). These measures of distributions
359 were computed for each year by using the Lorenz curve of mean stratum-level catch estimates
360 and the area of occupied strata (Swain and Sinclair 1994; Swain and Morin 1996).

361 **2.4.4 Length frequencies**

362 The length frequency distribution of catch (the stratified numbers-at-length) is tabulated for each
363 seven-year period (1970-2009), and last ten-year period (2010-2020).

364 **2.4.5 Length-weight relationship and condition factor**

365 The relationship between the weight and the length of fish was estimated using the following
366 non-linear isometric relationship:

$$W = \alpha L^\beta$$

367 where W is the total weight (g), L is the length (cm), and, α and β are the parameters to be
368 estimated.

369 Average fish condition (C) was computed as:

$$C = \frac{W}{\alpha L^\beta}$$

370

371 **2.4.6 Depth, temperature and salinity distribution of catches**

372 For each category L species, We followed the methods developed by (Perry and Smith 1994)
373 and generated cumulative frequency distributions of depth, temperature and salinity of survey
374 catches.

375 **2.4.7 Density-dependent habitat selection**

376 We followed the methods of (Myers and Stokes 1989) to evaluate how fish abundance in each
377 stratum varied with overall temporal fluctuations of population abundance.

378 For each category L species, we fitted a model of the relationship between stratum-level density
379 and overall abundance (the yearly stratified random estimate of abundance, defined above).
380 To properly use the observations of zero catch while accounting for the logarithmic distribution
381 of catch abundance, we implemented the model as a generalised linear using a log link and a
382 Poisson error distribution:

$$Y_{h,i} = \alpha_h Y_i^{\beta_h}$$

383 where, $y_{h,i}$ is the average abundance of stratum h in year i , and $\alpha_{h,i}$ and $\beta_{h,i}$ are the fitted
384 parameters. The estimated parameter $\beta_{h,i}$ is referred to as the “slope parameter” and indicates

385 whether stratum-level density is positively ($\beta_{h,i} \leq 0$), negatively ($\beta_{h,i} \geq 0$) or negligibly
386 ($\beta_{h,i} \approx 0$) related to population abundance.

387 To estimate the suitability of each stratum, the median abundance observed during the years
388 that are in the top 25% of yearly estimates is used. We combine the slope parameter estimates
389 from the above model with the median abundance to identify strata that have consistently high
390 abundance and whose local density is weakly related to fluctuation in population abundance
391 ($\beta_{h,i} \approx 0$). Preferred strata are identified for each category L species.

392 **2.5 Description of Figures**

393 **2.5.1 Type A**

394 For Category L and S species:

395 Spatial distribution of catch-per unit of effort, (CPUE, kilograms per tow) in July-August for the
396 Bay of Fundy and Scotian Shelf in five-year periods. Spatial interpolation between tows was
397 done using Inverse Distance Weight (IDW). The probability of occurrence (proportion of tows with
398 catch records for a given species) was also reported for each five-year period.

399 For Category LR and SR:

400 Location of tows with catch over the period 1970-2020 (Type LR) or the period 1999-2020 (Type
401 SR). Location of tows with catch over the period 1970-2020 (Type LR) or the period 1999-2020
402 (Type SR).

403 **2.5.2 Type B**

404 For Category L, S and I species:

405 Stratified random estimate of CPUE (left panel), distribution indices (D75% and D95%, the
406 minimum area containing 75% and 95% of biomass, middle panel), and distribution vs. weight
407 per tow (right panel). The stratified random mean is plotted as a solid line with the 95%
408 confidence region indicated by the solid grey line. The overall mean is plotted as a grey
409 horizontal line and the overall mean plus or minus 50% of the standard deviation appear as
410 horizontal dashed lines. In all three panels, the early years appear in blue and the last years
411 appear in red. The predictions from a loess estimator are overlaid on the distribution indices
412 (middle panel). The Pearson correlation coefficient between D75% and biomass, and its
413 statistical significance, are also reported in the right panel.

414 **2.5.3 Type C.**

415 Length frequency distribution for NAFO divisions 4X and 4VW. A smoothed length frequency
416 distribution is shown for each 7-year periods covered by the surveys.

417 **2.5.4 Type D.**

418 Average fish condition for all fish lengths (black dots and black line), large fish (thick gray line),
419 and small fish (thin gray line). Fish condition is presented for NAFO divisions 4VW (right panel)
420 and 4X (left panel).

421 **2.5.5 Type E.**

422 Cumulative frequency distributions of depth, temperature and salinity at all sampled locations
423 (thick solid line) and at fishing locations with catch records (thin dashed line). The depth,
424 temperature and salinity associated with 5%, 25%, 50%, 75% and 95% of the cumulative catch is
425 shown in tabular fashion on the bottom right panel.

426 **2.5.6 Type F.**

427 Slopes estimates from the density-dependent habitat selection model (y axis) plotted versus
428 the median abundance during the top 25% of years. The red box indicates strata of particular
429 importance for a species by identifying slopes that are within a standard error from zero and that
430 are within the top 25% of median abundance. Each stratum is identified on the plot by the last
431 two digits of its number.

432 **3 Results**

433 The plots generated for each species are presented in the Appendix.

434 **3.1 Summary of successful tows by year and stratum**

435 A total of 9080 representative tows were conducted for the period spanning from 1970 to 2020
436 (Figure 4).

437 Tables 4, 5 and 6 present the number of tows conducted in each stratum and year.

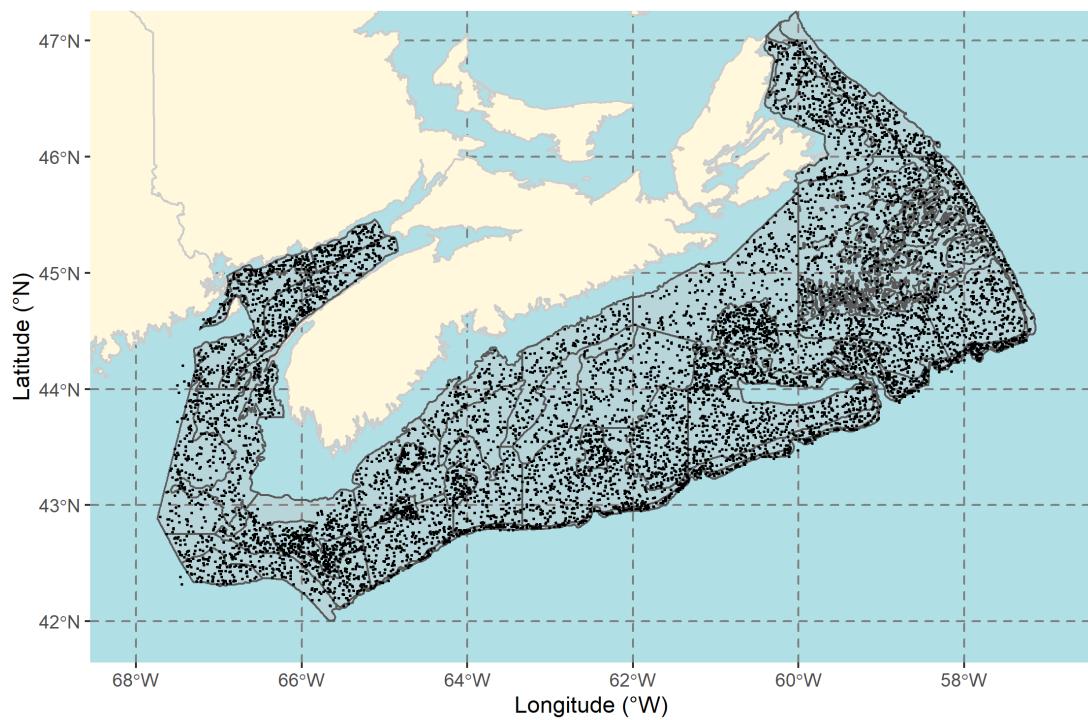


Figure 4. Map of the 9080 representative tows in the Summer survey from 1970 to 2020.

Table 4. Number of representative tows conducted in each stratum during the period 1970 to 1989.

Stratum	NAFO Div.	Area (km ²)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
440	4VN	3173.016	4	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	5	5	6	4
441	4VN	3434.000	4	2	2	3	3	3	1	3	3	3	3	3	3	3	3	5	5	4	4	4
442	4VN	4934.658	3	2	2	2	3	3	2	3	3	3	3	3	3	3	3	3	5	6	7	5
443	4VSW	4526.012	4	2	4	4	8	3	1	2	4	4	4	3	3	5	4	4	6	6	5	2
444	4VSW	13478.450	3	2	5	4	6	4	6	7	4	4	4	5	5	6	4	4	6	6	3	6
445	4VSW	3512.982	5	2	5	4	5	5	1	3	4	4	4	5	5	3	4	5	6	4	4	4
446	4VSW	1686.094	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3
447	4VSW	5549.344	4	2	6	5	7	4	4	3	4	4	4	5	4	4	4	4	5	7	6	6
448	4VSW	4975.866	5	2	5	4	5	4	4	4	4	4	4	4	6	4	4	4	5	5	5	5
449	4VSW	494.496	2	2	2	2	3	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2
450	4VSW	1315.222	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
451	4VSW	504.798	1	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2
452	4VSW	1184.730	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2
453	4VSW	889.406	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
454	4VSW	1713.566	3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	2
455	4VSW	7286.948	7	6	7	6	7	6	6	7	7	7	7	7	7	7	7	8	7	7	7	7
456	4VSW	3279.470	5	4	6	5	5	6	4	6	6	6	7	6	6	6	6	6	7	6	6	6
457	4VSW	2784.974	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	4	2	2
458	4VSW	2259.572	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
459	4VSW	10810.232	3	2	4	4	4	4	4	4	4	4	4	4	3	4	4	6	6	5	6	5
460	4VSW	4615.296	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	4	3	3	3
461	4VSW	3962.836	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2
462	4VSW	7266.344	3	3	4	3	4	4	4	4	4	4	4	6	4	4	4	4	6	5	4	4
463	4VSW	1037.068	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2
464	4VSW	4453.898	4	3	5	3	3	6	5	5	5	5	5	4	5	5	5	7	6	5	5	5
465	4VSW	8183.222	6	5	5	4	5	4	5	5	5	5	5	7	6	5	5	5	8	8	8	8
466	4VSW	776.084	2	2	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	2
470	4X	3159.280	1	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3
471	4X	3447.736	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
472	4X	4289.066	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
476	4X	5075.452	2	2	2	2	2	2	3	2	2	2	1	2	2	2	2	2	2	4	4	4
477	4X	4230.688	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	5	4	4
478	4X	800.122	2	2	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	2	2	2
480	4X	2249.270	4	4	4	3	3	3	4	4	3	4	3	3	4	4	4	4	4	4	4	4
481	4X	6438.750	5	3	4	4	4	3	4	4	5	4	3	4	4	4	4	4	4	6	7	6
482	4X	3578.228	2	1	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	3	3	3
483	4X	1826.888	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2
484	4X	7774.576	2	2	3	3	3	3	3	3	2	3	3	3	4	3	3	3	4	4	4	4
485	4X	5432.588	2	2	2	3	3	3	3	3	3	2	3	4	3	3	3	3	6	7	6	6
490	4X	2063.834	2	2	2	2	2	3	3	3	3	2	3	3	3	3	3	3	3	4	4	4
491	4X	2359.158	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
492	4X	3729.324	3	2	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
493	4X	1830.322	1	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
495	4X	2005.456	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2
		171809.888	134	110	146	134	153	143	135	144	141	147	145	150	150	146	143	152	171	188	177	170

Table 5. Number of representative tows conducted in each stratum during the period 1990 to 2009.

Stratum	NAFO Div.	Area (km ²)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
440	4VN	3173.016	4	4	4	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4	3	4	
441	4VN	3434.000	6	5	5	5	5	5	5	5	6	7	6	6	7	6	7	6	6	5	6		
442	4VN	4934.658	5	5	6	5	6	6	6	6	7	6	6	5	6	6	7	5	5	5	6		
443	4VSW	4526.012	4	2	4	3	3	4	4	5	5	4	4	5	5	5	5	4	4	4	5	4	
444	4VSW	13478.450	7	8	8	9	6	8	8	7	8	8	9	10	9	9	9	8	10	8	6	9	
445	4VSW	3512.982	4	4	4	5	7	4	4	4	3	3	6	5	5	5	5	6	5	4	3	6	
446	4VSW	1686.094	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	
447	4VSW	5549.344	8	7	7	7	7	7	6	7	7	6	7	7	7	7	7	7	6	6	4	6	
448	4VSW	4975.866	9	6	6	7	7	7	6	7	6	7	8	8	8	8	7	8	8	6	5	7	
449	4VSW	494.496	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	
450	4VSW	1315.222	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	
451	4VSW	504.798	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	2	2	
452	4VSW	1184.730	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
453	4VSW	889.406	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	
454	4VSW	1713.566	3	2	2	2	2	2	3	2	2	2	2	2	2	2	2	3	2	2	2	2	
455	4VSW	7286.948	12	10	10	9	10	10	10	13	8	11	11	11	11	11	8	12	11	7	5	8	
456	4VSW	3279.470	10	7	7	8	8	8	8	8	6	8	10	8	8	8	8	8	8	6	2	7	
457	4VSW	2784.974	4	2	2	2	2	2	2	2	1	4	2	2	2	2	2	2	2	2	2	2	
458	4VSW	2259.572	9	8	8	8	8	8	7	8	5	6	10	8	7	8	8	10	8	5	2	7	
459	4VSW	10810.232	5	5	6	4	6	6	4	5	6	6	8	6	6	6	6	6	6	5	3	6	
460	4VSW	4615.296	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	2	3	3	
461	4VSW	3962.836	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	
462	4VSW	7266.344	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	3	4	4	
463	4VSW	1037.068	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	
464	4VSW	4453.898	9	7	7	7	7	7	7	4	7	7	7	7	7	7	5	8	7	6	4	5	
465	4VSW	8183.222	12	9	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	7	8	7	
466	4VSW	776.084	3	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	2	1	3	2	
470	4X	3159.280	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
471	4X	3447.736	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	
472	4X	4289.066	6	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	3	4	3	
473	4X	910.010	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
476	4X	5075.452	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	
477	4X	4230.688	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
478	4X	800.122	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2	
480	4X	2249.270	8	8	8	8	8	8	8	8	8	8	7	8	8	8	7	9	8	8	8	8	
481	4X	6438.750	8	9	9	9	9	7	9	9	9	9	8	9	8	9	8	9	6	12	9	7	8
482	4X	3578.228	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	4	3	3	3	
483	4X	1826.888	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
484	4X	7774.576	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	4	4	3	4	
485	4X	5432.588	2	3	3	3	3	3	3	3	3	3	3	4	3	5	5	3	2	5	4	5	
490	4X	2063.834	4	4	4	4	4	5	4	4	4	3	4	4	4	4	4	4	3	3	3	4	
491	4X	2359.158	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	4	
492	4X	3729.324	3	3	3	3	3	2	3	3	3	3	3	3	3	3	5	2	3	4	4	4	
493	4X	1830.322	3	3	3	3	3	2	3	3	2	3	3	3	4	5	2	4	4	3	3	4	
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	
495	4X	2005.456	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5	3	3	4	
		171809.888	213	189	193	190	195	195	191	193	186	191	213	201	208	216	188	222	209	177	165	196	

Table 6. Number of representative tows conducted in each stratum during the period 2010 to 2020 and for the whole 1970 to 2020 period.

Stratum	NAFO Div.	Area (km2)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
440	4VN	3173.016	4	5	4	4	4	4	4	4	0	5	4	190
441	4VN	3434.000	6	7	6	6	6	6	6	6	0	7	4	238
442	4VN	4934.658	5	6	6	6	6	6	6	6	0	6	5	240
443	4VSW	4526.012	4	6	5	5	3	7	4	5	0	9	4	214
444	4VSW	13478.450	11	13	9	8	9	9	11	10	0	6	8	352
445	4VSW	3512.982	4	7	2	4	3	4	4	4	0	6	3	215
446	4VSW	1686.094	3	4	3	3	3	2	3	2	0	3	2	145
447	4VSW	5549.344	6	8	6	7	7	7	7	7	0	6	5	291
448	4VSW	4975.866	7	10	8	8	8	7	6	6	0	7	4	299
449	4VSW	494.496	2	4	2	2	2	2	2	2	0	2	2	100
450	4VSW	1315.222	3	3	3	3	3	3	3	2	0	3	2	144
451	4VSW	504.798	2	2	2	2	2	2	2	2	0	2	2	104
452	4VSW	1184.730	2	2	2	2	1	4	3	3	0	3	3	110
453	4VSW	889.406	2	1	3	2	3	2	2	1	0	2	2	116
454	4VSW	1713.566	2	4	2	2	2	2	2	2	0	3	2	121
455	4VSW	7286.948	10	10	10	11	11	9	9	8	0	9	6	429
456	4VSW	3279.470	7	9	8	8	6	5	6	6	0	6	4	331
457	4VSW	2784.974	2	4	2	2	2	3	3	3	0	3	2	113
458	4VSW	2259.572	6	9	8	6	4	5	5	5	0	6	3	269
459	4VSW	10810.232	6	7	6	6	6	7	7	6	0	9	7	262
460	4VSW	4615.296	3	4	4	3	3	5	5	5	3	6	5	151
461	4VSW	3962.836	2	3	3	2	2	3	3	3	2	3	3	113
462	4VSW	7266.344	4	6	4	4	5	5	5	5	0	5	5	212
463	4VSW	1037.068	2	3	2	2	2	3	2	2	0	2	2	107
464	4VSW	4453.898	6	7	7	7	7	6	6	4	0	6	4	288
465	4VSW	8183.222	8	10	10	10	10	9	7	3	10	7	397	
466	4VSW	776.084	2	2	2	2	2	2	2	3	0	3	2	118
470	4X	3159.280	2	2	3	2	2	3	3	3	4	3	2	112
471	4X	3447.736	2	2	3	2	2	3	3	3	4	4	3	110
472	4X	4289.066	4	6	4	4	4	4	4	4	4	4	4	172
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	104
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	100
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	103
476	4X	5075.452	4	4	4	4	4	5	5	5	5	5	5	177
477	4X	4230.688	5	4	5	5	6	5	5	4	4	6	4	204
478	4X	800.122	2	2	2	2	2	2	2	3	2	2	2	119
480	4X	2249.270	8	7	8	8	6	7	7	5	7	5	7	306
481	4X	6438.750	8	10	9	9	9	8	10	9	6	9	6	350
482	4X	3578.228	3	4	3	3	3	3	4	4	3	4	3	141
483	4X	1826.888	2	3	2	2	2	2	3	3	2	3	2	105
484	4X	7774.576	3	5	5	5	4	6	5	7	7	7	7	186
485	4X	5432.588	5	6	5	5	5	6	6	6	4	6	5	196
490	4X	2063.834	3	4	2	4	3	4	4	4	3	4	3	173
491	4X	2359.158	4	4	4	4	4	4	4	4	3	4	3	168
492	4X	3729.324	4	6	4	4	4	3	4	4	3	4	4	171
493	4X	1830.322	3	4	4	4	3	3	4	6	3	3	3	159
494	4X	1431.978	4	4	4	4	3	4	4	3	2	4	3	128
495	4X	2005.456	3	4	4	4	2	4	4	4	3	4	3	127
		171809.888	196	243	210	208	196	212	214	208	81	227	175	9080

438 **3.2 Distribution of depth, bottom temperature and bottom salinity from survey tows**

439 The depth, bottom temperature and bottom salinity cumulative frequency distribution for the
440 survey are presented in Figure 5.

441 **3.2.1 Decadal distribution of surface and bottom temperatures**

442 The decadal cumulative frequency distribution of surface and bottom temperatures are presented
443 in Figure 6.

444 **4 Discussion**

445 This report builds on previous work and former atlases by updating a comprehensive suite of
446 indices to give a snapshot of population status and environmental preferences of 104 fish and
447 invertebrate species. The current document is not meant to replace stock assessments, species-
448 specific analyses of abundance, biomass and distribution, or any targeted attempts to integrate
449 information about species or group of species from the wide and disparate sources of data about
450 marine organisms in the area covered by the DFO Maritimes summer trawl survey. It is rather
451 meant to provide a reproducible set of tools to extract and visualize the information collected
452 in the summer groundfish research vessel survey. It is hoped that this document can provide a
453 stepping stone to conduct other ecological analyses using the trawl survey data and increase
454 reproducibility and transparency of ecological information collected annually.

455 **4.1 Diversity of approaches used for mapping fish and invertebrates in the Scotian Shelf
456 bioregion**

457 Different methods have been applied in the Northwest Atlantic, and specifically on the Scotian
458 Shelf bioregion, to map fish and invertebrate species distribution. The present report, for
459 example, builds upon the atlas of important habitat developed to map the persistence of relatively
460 high biomass for key fish species using the summer groundfish research vessel survey (Horsman
461 and Shackell 2009). Important habitat was obtained by interpolating observed weight per each
462 species using an inverse-distance weighted (IDW) methodology, and calculating areas with
463 relatively persistent high biomass for periods representing different fishery management eras.
464 To compliment information from this atlas, including additional representations of biomass and
465 diversity, a similar IDW interpolation mapping procedure was followed by Smith et al. (2015),
466 Ward-Paige and Bundy (2015), and Bundy et al. (2017). The summer groundfish research vessel
467 survey is typically conducted during the month of July. However, from the fall of 1978 through to
468 the spring of 1985, DFO also conducted spring and fall surveys using the same sampling design.
469 This unique seasonal data was used to map the seasonal spatial distribution of key demersal
470 and other fish species using IDW interpolation on the Scotian Shelf from the spring, summer
471 and fall between 1978 and 1985 (Smith et al. 2015). Following recommendations provided by
472 Kenchington and Kenchington (2017), the spatial distribution of three indicators of biodiversity

473 for fish and invertebrates were mapped using IDW interpolation to identify areas with persistently
474 high values across fishery management eras, and compared with areas of persistently high
475 abundance for selected species (Ward-Paige and Bundy 2015). This analysis revealed a lack of
476 consistent relationships between areas of persistent high diversity and persistent high biomass,
477 suggesting that both can be used as independent and important spatial indicators of the system
478 (Ward-Paige and Bundy 2015). Groupings of fishes and invertebrates based on size, habitat
479 and feeding guild, were also mapped using IDW interpolations to identify hotspots of functional
480 group diversity (Bundy et al. 2017). This analysis revealed a spatially and temporally variable
481 distribution of functional diversity across the Scotian Shelf with notable areas of high and low
482 diversity (Bundy et al. 2017). Top quintiles of each functional group using the IDW approach
483 were used as representative layers for fish and invertebrates in the MPA Network design in the
484 Scotian Shelf Bioregion (Serdynska et al. In press). IDW interpolation methods have also been
485 used to map the distribution of individual species such as sea cucumbers (*Cucumaria frondosa*)
486 in the Scotian Shelf bioregion (Shackell et al. 2013), and sea scallop (*Placopecten magellanicus*)
487 in Georges and Browns Bank (Hubley et al. 2014).

488 Species Distribution Modelling (SDM), instead of IDW, can also be used to evaluate spatio-
489 temporal dynamics by predicting and understanding past, present and future distribution
490 of species using environmental predictors (Robinson et al. 2017). A variety of modelling
491 approaches are being implemented in Maritimes Region to map and predict fish and invertebrate
492 species distribution by incorporating environmental predictors to account for seasonal and
493 temporal variability. For example, a stock assessment of snow crab (*Chionoecetes opilio*) on
494 the Scotian Shelf used data from the snow crab survey from 2005 to 2018 to map spatial data
495 products for this stock, including annual predicted interpolations of potential habitat using
496 Generalized Additive Models (GAM) and several environmental covariates including depth,
497 curvature, slope, species composition, and annual temperature (Zisserson et al. 2019). Sea
498 scallop predicted habitat using Maximum Entropy (MaxEnt) models were computed for German
499 Bank using data compiled via benthic habitat mapping and seafloor geotechnical surveys in
500 2006, 2009, and 2010 (Brown et al. 2012). Predictions in the Scotian Shelf bioregion and the
501 Northeast United States using datasets from DFO and the National Oceanic and Atmospheric
502 Administration from 1993 to 2012 also predicted sea scallop habitat at a wider scale based
503 on three scenarios of seasonal temperature and salinity climatologies (NOAA) (Lowen et
504 al. 2019). Offshore American lobster stock assessments (*Homarus americanus*) used data
505 from the RV, DFO Georges Bank, and National Marine Fisheries Service (NMFS) Northeast
506 Fisheries Science Center (NEFSC) bottom trawl surveys (1970 to 2015) to predict species
507 distribution using boosted regression trees and several environmental predictors (bathymetry,
508 slope, curvature, and annual temperature interpolations) (Cook et al. 2017). Information on
509 the potential for recovery of cusk (*Brosme brosme*) used data from the bottom longline Halibut
510 industry survey and Cusk absences in the Summer groundfish research vessel survey from
511 1998-2013 to predict suitable habitat using GAM, MaxEnt, and random forest models and
512 several physical environmental variables (e.g. complexity, benthic current stress and complexity,
513 temperature, salinity, primary production, chlorophyll, suspended matter) (Harris et al. 2018).
514 Atlantic halibut (*Hippoglossus hippoglossus*) assessments using Summer groundfish research
515 vessel survey and NOAA survey data from 2001 to 2013 predicted juvenile habitat using MaxEnt
516 model and environmental predictors (bathymetry, slope, bottom temperature) (French et al.
517 2018). Persistent areas of high Atlantic halibut juvenile abundance were predicted using data
518 from 27 bottom trawl surveys combined (NMFS and DFO) from 1978 to 2013 and applying
519 Bayesian hierarchical spatiotemporal models with two environmental predictors (depth and

520 temperature) (Boudreau et al. 2017).

521 These examples of mapping efforts in Maritimes Region showcase the diversity of approaches
522 relevant to a variety of important research questions and management applications. Approaches,
523 methods, datasets, and environmental predictors are selected based on individual project
524 research questions, and considerations for each species, communities or stock. This allows
525 research groups to maintain innovation and keep up with emerging methods and technologies to
526 improve assessments, predictions, and ultimately, science advice. The diversity of approaches
527 also leads to complexity when looking across studies as each data compilation and predictive
528 method carries its own independent assumptions and can lead to different spatial outputs.

529 **4.2 Interpreting spatial results for marine spatial planning purposes**

530 Fisheries and Oceans Canada is leading a marine spatial planning process that brings together
531 relevant authorities and stakeholders to better coordinate how we use and manage marine
532 spaces to achieve ecological, economic and social objectives. Operationalizing marine spatial
533 planning includes a series of steps, including the process of analyzing existing conditions
534 by collecting and mapping information about ecological, environmental and oceanographic
535 conditions (Ehler and Douvere 2009; Agardy et al. 2011). Mapping the distribution of species
536 is critical for the implementation of spatial management and as a first step in marine spatial
537 planning processes. Species distribution have supported the identification of important sites for
538 a given species or areas of high richness and diversity, which in turn can be used to inform siting
539 decisions of new activities such as Marine Protected Areas (MPA), aquaculture sites or wind
540 turbines. In the Scotian Shelf bioregion, mapping species distributions has been used to highlight
541 areas of high biological diversity to support the identification of Ecologically or Biologically
542 Significant Areas (Ricard and Shackell 2013; Ward-Paige and Bundy 2015), to distinguish
543 important and persistent habitat of significant species and functional groups to support MPA and
544 conservation planning (Horsman and Shackell 2009; Smith et al. 2015; Ward-Paige and Bundy
545 2015; Bundy et al. 2017), to identify important habitat for Species at Risk (Harris et al. 2018) and
546 to highlight reserves for data-poor invertebrate fisheries (Shackell et al. 2013). Mapping species
547 distribution has also been used to illustrate multi-decadal scale projections of changes in species
548 distribution in the context of climate change and adaption (Stanley et al. 2018; Greenan et al.
549 2019).

550 In support of the marine spatial planning process, a public web-based atlas with relevant
551 geospatial information is being developed to support decision-making. This Atlantic Canada-
552 wide compilation of data and information will be a web-based, public platform with interactive
553 maps of ocean ecosystems, human uses and management areas. The current document cannot
554 present the full diversity of data and mapping products that can be produced for the Maritimes
555 Region. Consequently, we recommend that the data and mapping products presented in this
556 report not be used blindly for the planned atlas, until an evaluation of what spatial information is
557 available and what was used in the past is conducted.

558 This diverse portfolio of approaches and applications is not unique to the Maritimes Region. A
559 recent review of global distribution modelling efforts recommended the adoption of a consistent
560 framework that integrates multi-model approaches and a clear expression of errors and
561 uncertainties (Robinson et al. 2017). In this context, Pacific Region has developed two initiatives

562 to enable consistency and frequent publication, reproducibility, and transparency. One initiative
563 developed a reproducible report to give a synthesis of data availability, population trends, fishing
564 trends, growth and maturity patterns for 113 groundfish species in British Columbia to support
565 stock assessment (Anderson et al. 2019). The second initiative developed a SDM framework
566 that was applied to twelve species on Canada's Pacific coast as part of the Regional Response
567 Plan (Nephin et al. 2019). The Maritimes and Gulf region, through this and past reports, are also
568 using similar reproducible approaches to facilitate annual updates and transparency (Ricard et al.
569 in prep.; Ricard and Shackell 2013).

570 Recognizing the diversity of approaches for mapping fish and invertebrates in the Scotian Shelf
571 bioregion, we recommend the development of a regional community of practice to compare
572 and evaluate approaches for mapping, interpolating and/or modelling fish and invertebrates
573 so future publications and advice related to spatial outputs can lead to more comparable work
574 and consistent science advice to support processes such as marine spatial planning. At the
575 international level, guidelines and standards related to appropriate variables and methods
576 for mapping and modeling species and communities of deep-sea habitats were proposed to
577 encourage the production of publications that will lead to more comparable work (Kenchington
578 et al. 2019). Similar general guidance for how groups approach mapping activities would be a
579 worthwhile product in Maritimes Region. Until then, we propose the use of the Open Data record
580 for the Maritimes RV surveys (DFO 2021) as a precursor to the public web-based marine spatial
581 planning atlas.

582

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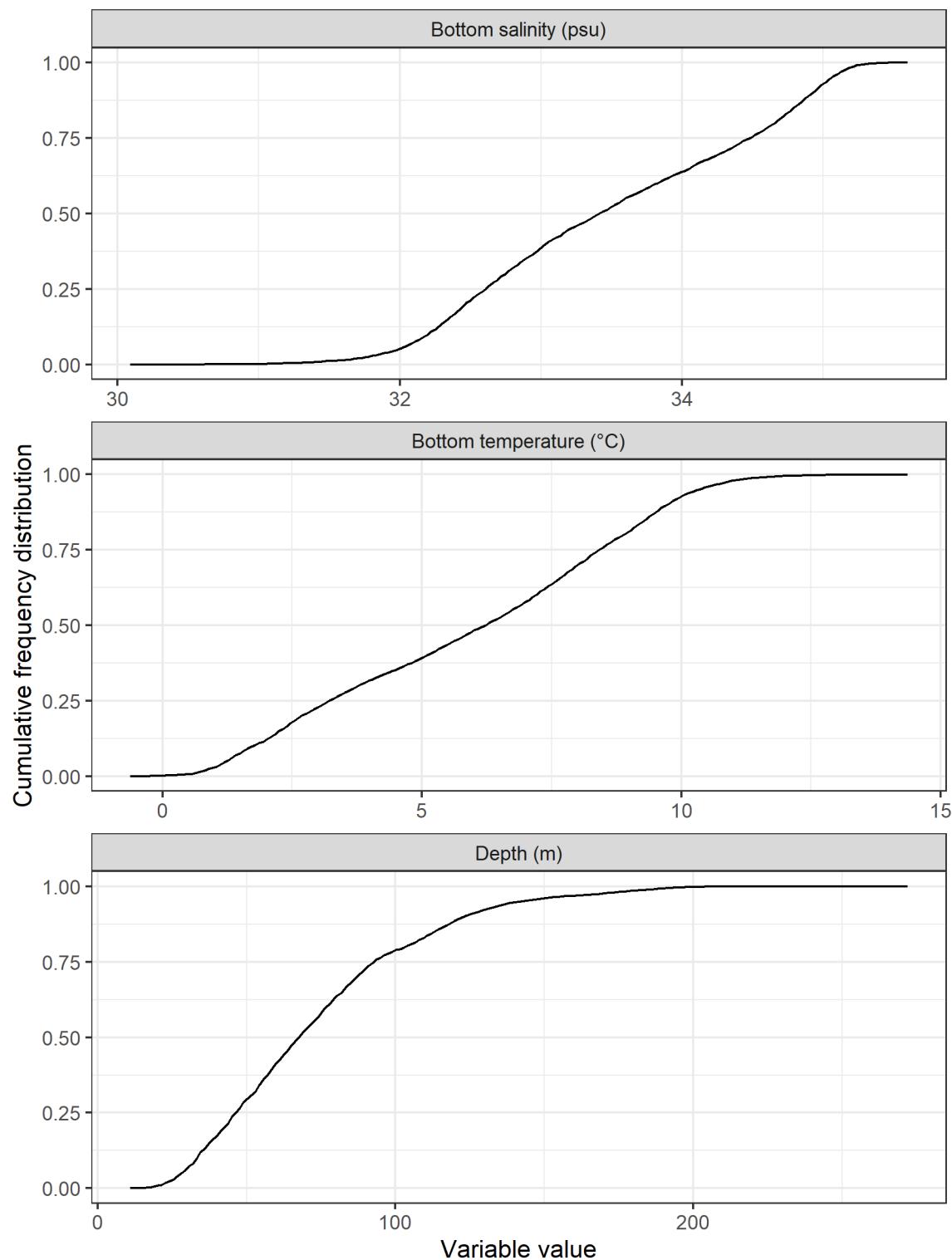


Figure 5. Cumulative frequency distribution of bottom salinity (top panel), bottom temperature (middle panel) and depth (bottom panel) of representative sets from the DFO Maritimes summer survey.

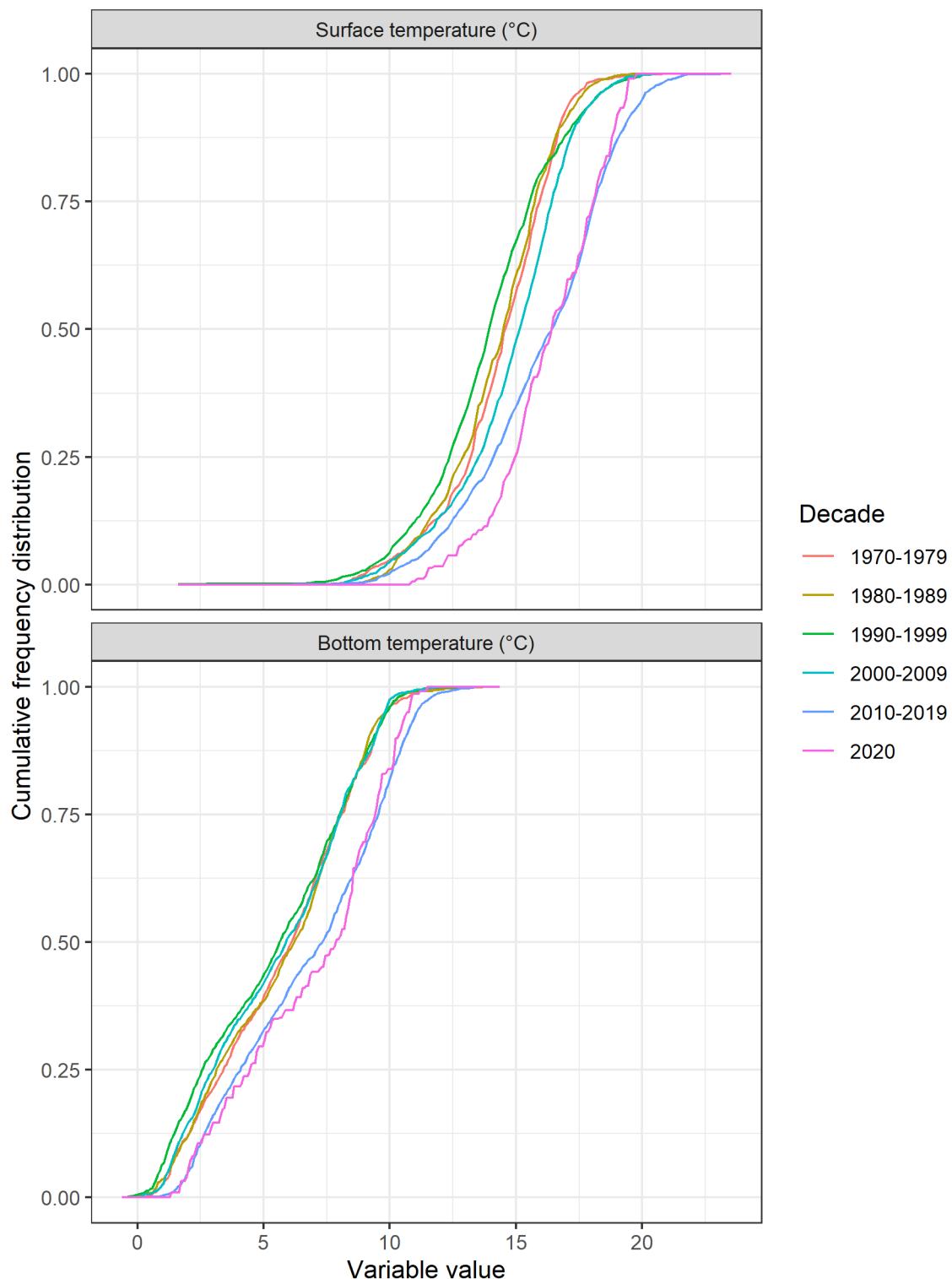


Figure 6. Decadal cumulative frequency distribution of surface temperature (top panel) and bottom temperature (bottom panel) of representative sets from the DFO Maritimes summer survey.

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7 Appendix

749

7.1 Atlantic cod (*Morue franche*) - species code 10 (category LF)

750

Scientific name: [Gadus morhua](#)

751

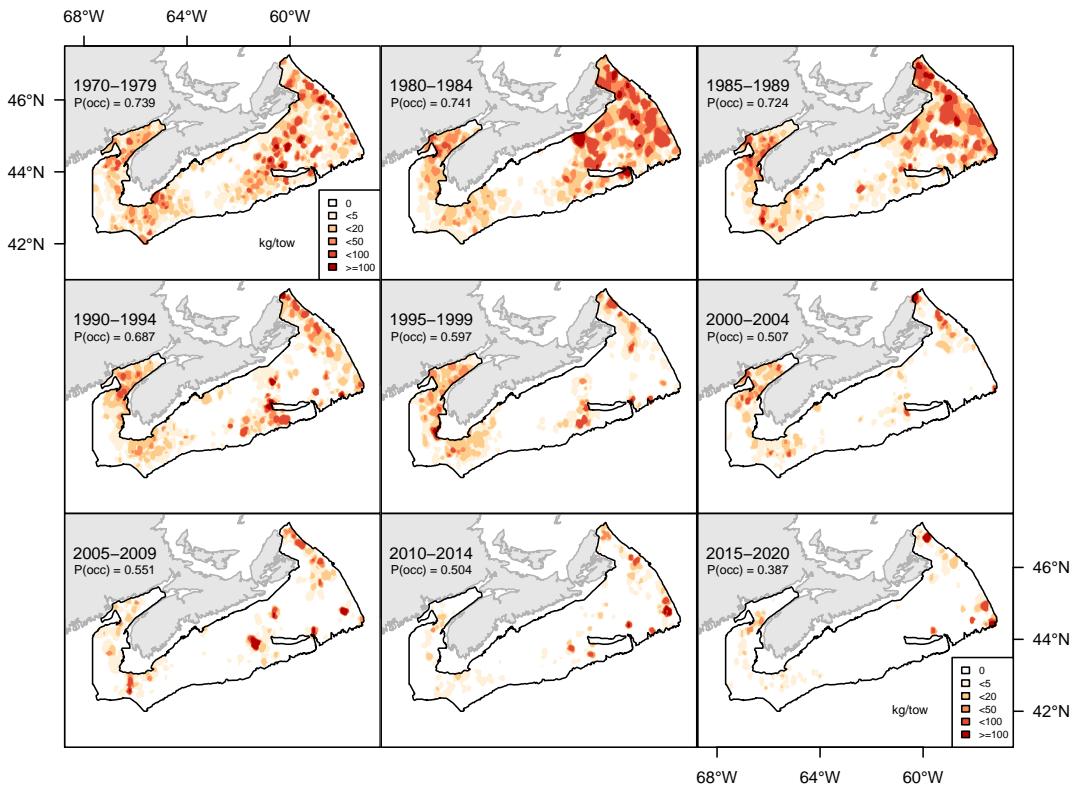


Figure 7.1A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic cod.

752

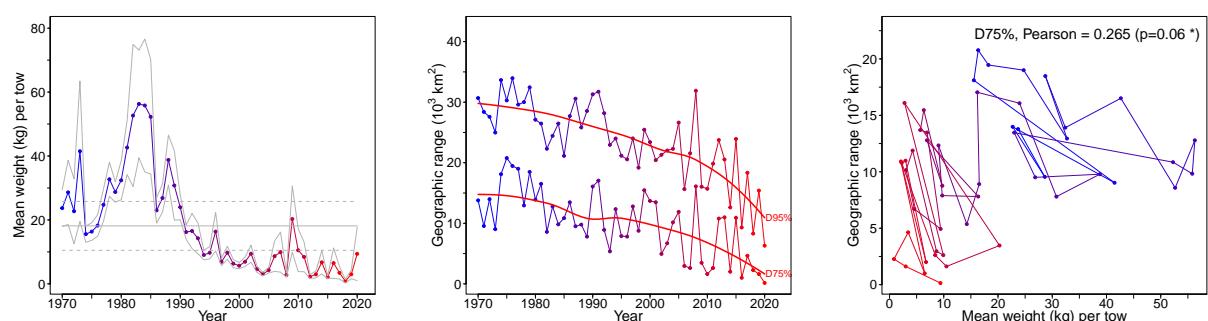


Figure 7.1B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic cod.

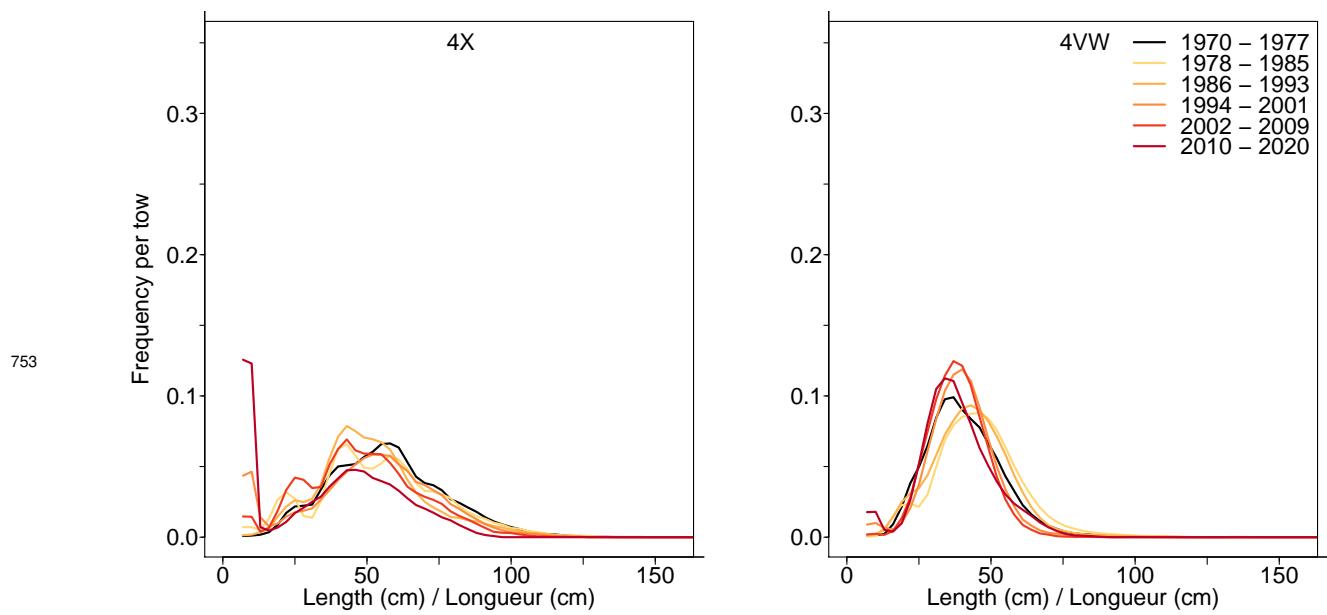


Figure 7.1C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic cod.

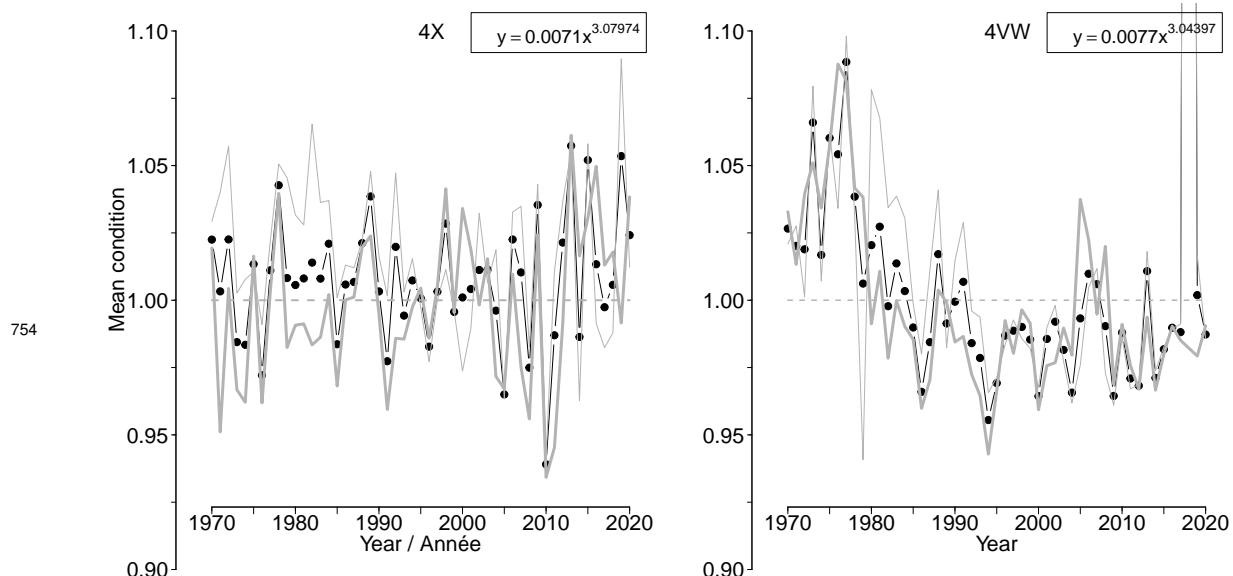
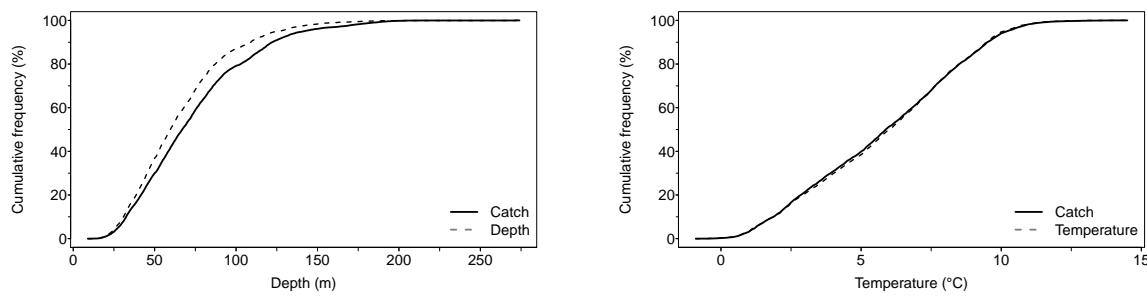
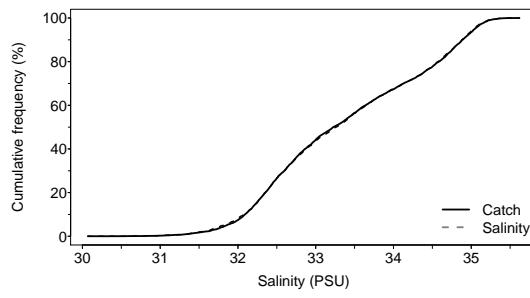


Figure 7.1D. Average fish condition in NAFO units 4X and 4VW for Atlantic cod.



755



Freq	Depth	Temp	Sal
F5	26	1.2	31.00
F25	43	3.5	32.47
F50	60	6.0	33.27
F75	82	8.1	34.40
F95	126	10.0	35.03

Figure 7.1E. Catch distribution by depth, temperature and salinity of Atlantic cod.

756

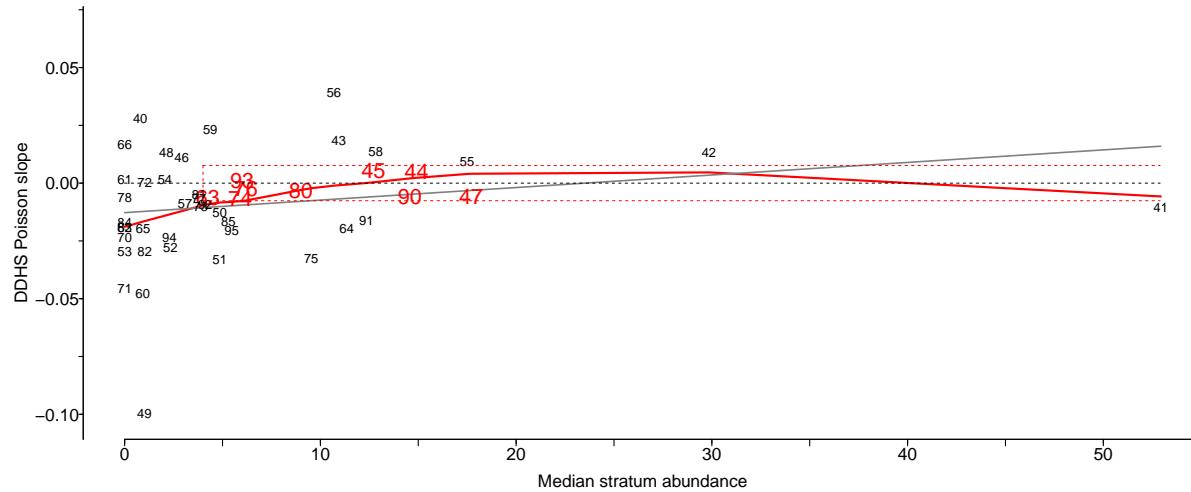


Figure 7.1F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic cod.

757

7.2 Haddock (Aiglefin) - species code 11 (category LF)

758

Scientific name: [Melanogrammus aeglefinus](#)

759

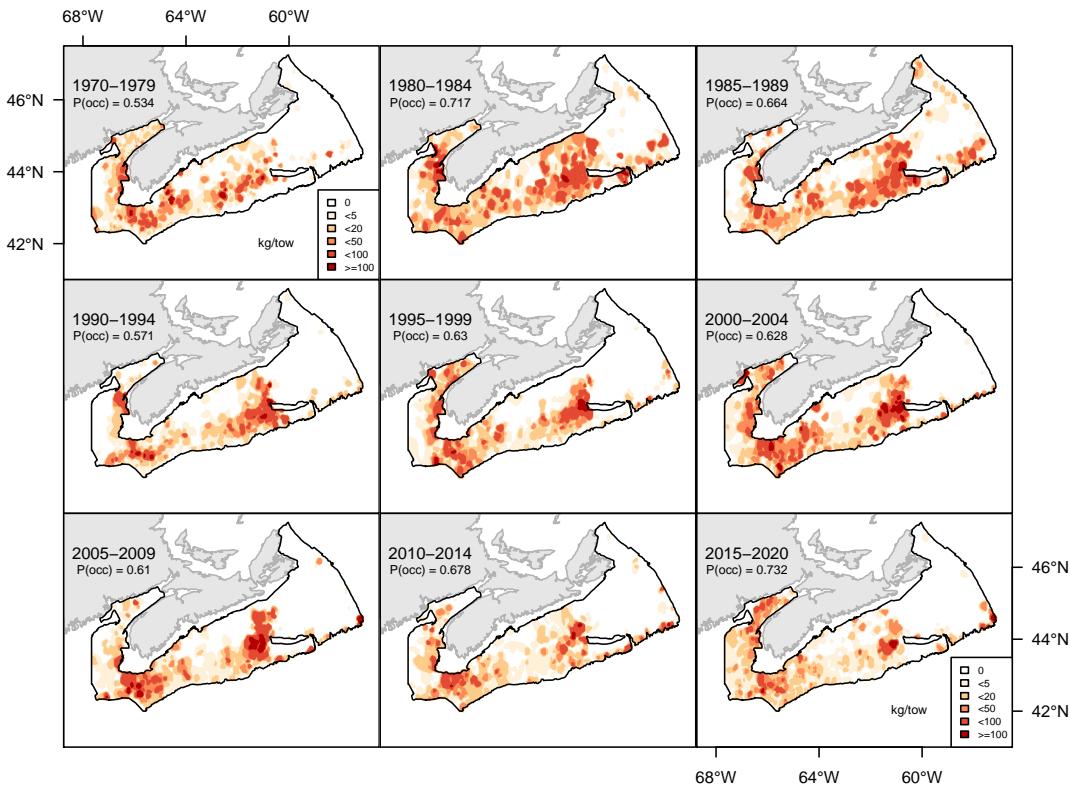


Figure 7.2A. Inverse distance weighted distribution of catch biomass (kg/tow) for Haddock.

760

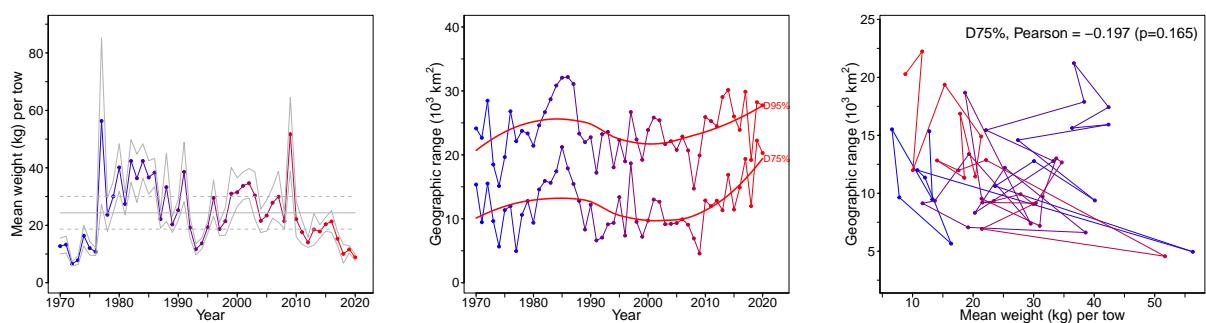


Figure 7.2B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Haddock.

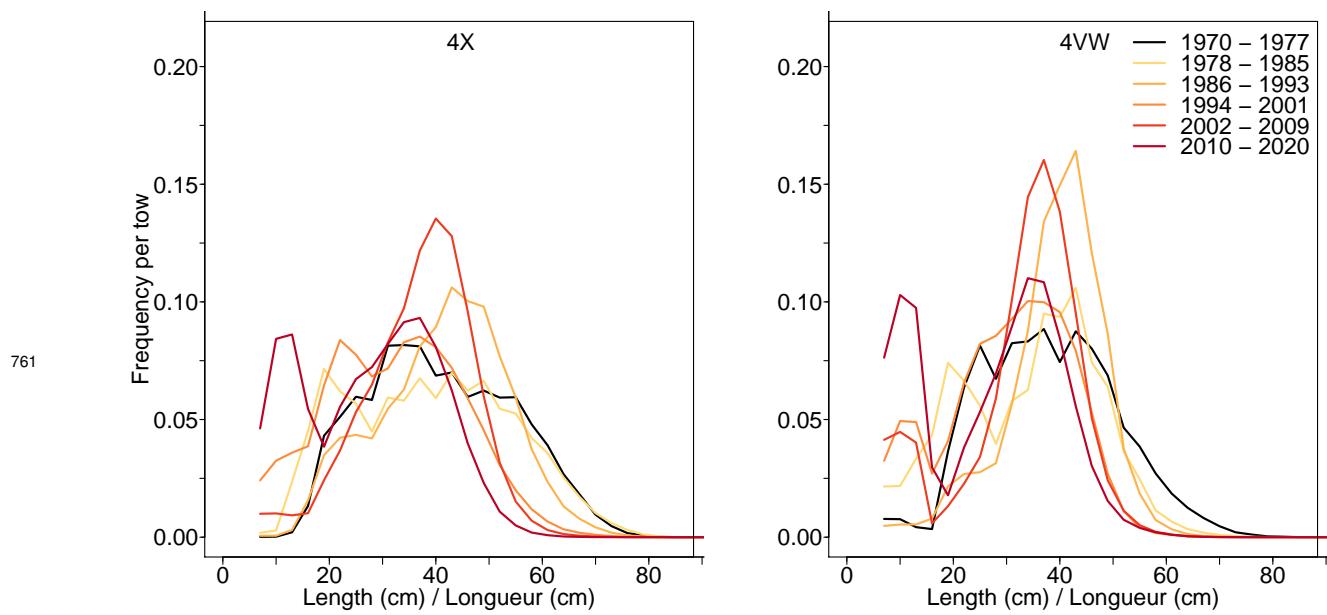


Figure 7.2C. Length frequency distribution in NAFO units 4X and 4VW for Haddock.

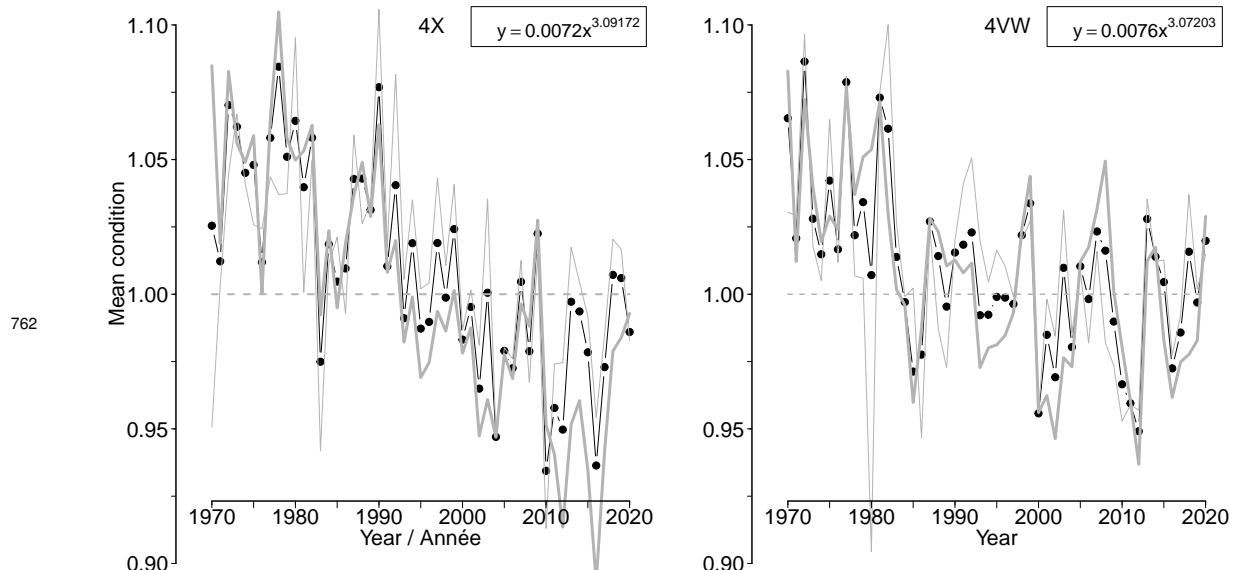
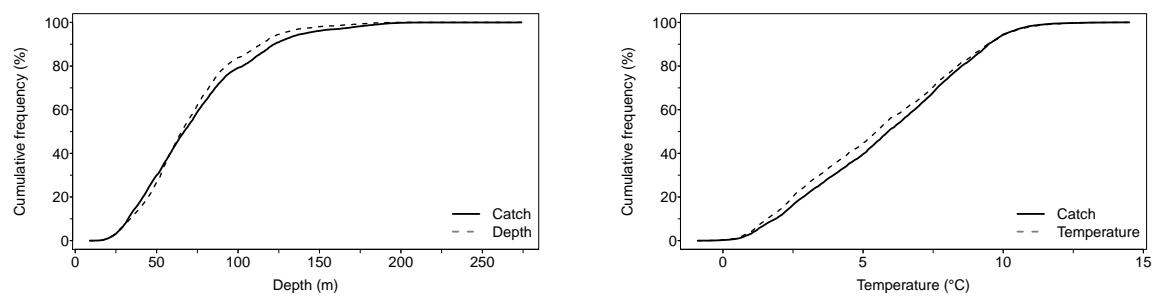
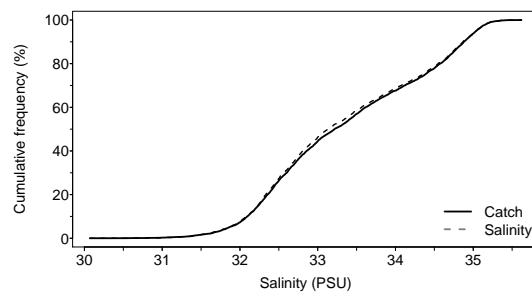


Figure 7.2D. Average fish condition in NAFO units 4X and 4VW for Haddock.



763



Freq	Depth	Temp	Sal
F5	27	1.1	31.00
F25	49	3.0	32.45
F50	66	5.5	33.14
F75	87	7.9	34.36
F95	127	10.0	35.03

Figure 7.2E. Catch distribution by depth, temperature and salinity of Haddock.

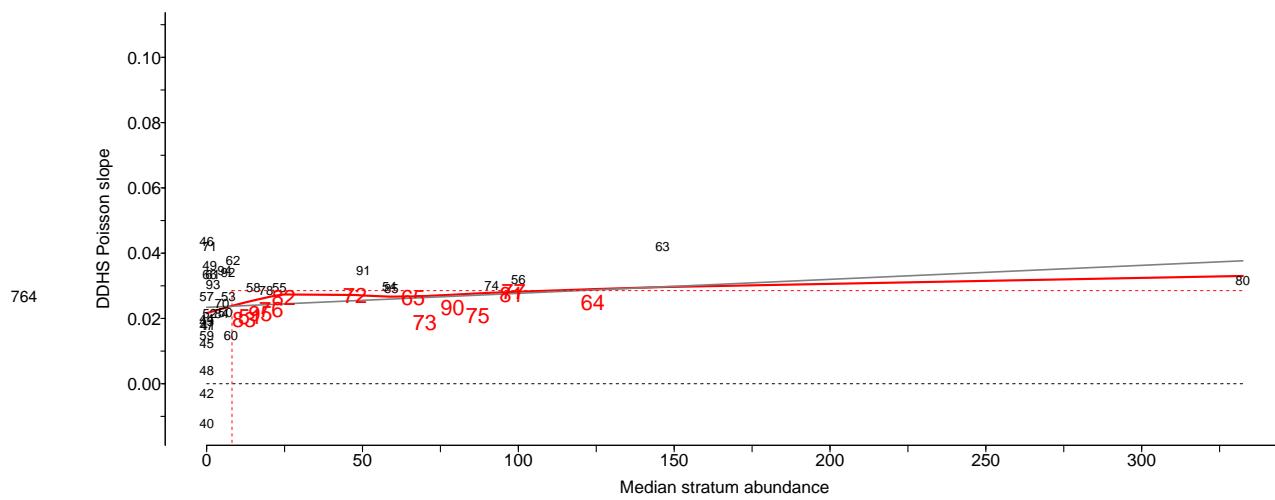


Figure 7.2F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Haddock.

765 **7.3 White hake (*Merluche blanche*) - species code 12 (category LF)**

766 Scientific name: [Urophycis tenuis](#)

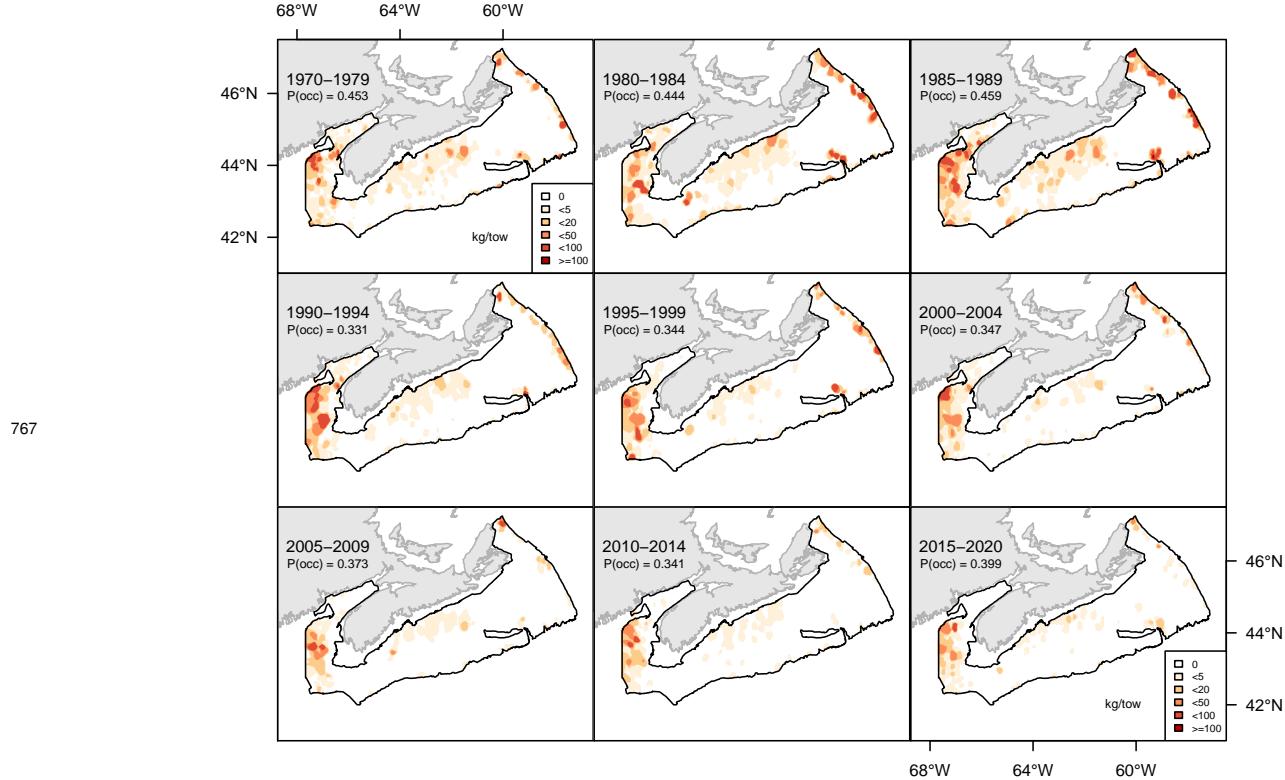


Figure 7.3A. Inverse distance weighted distribution of catch biomass (kg/tow) for White hake.

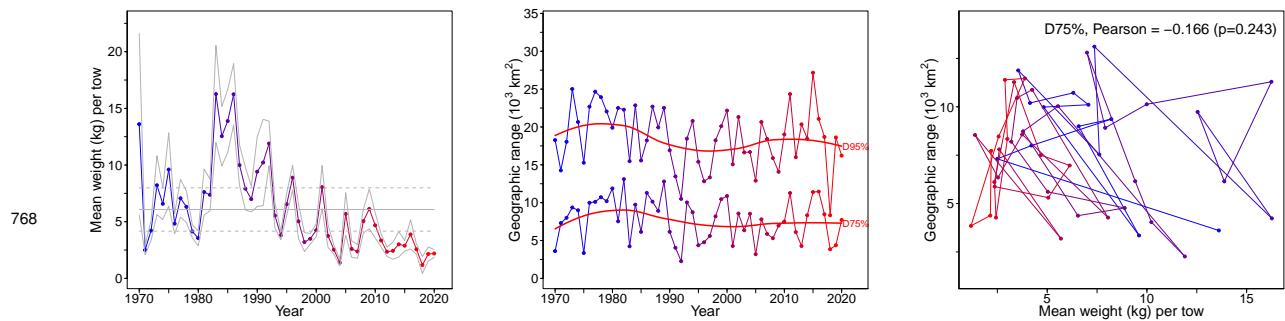


Figure 7.3B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of White hake.

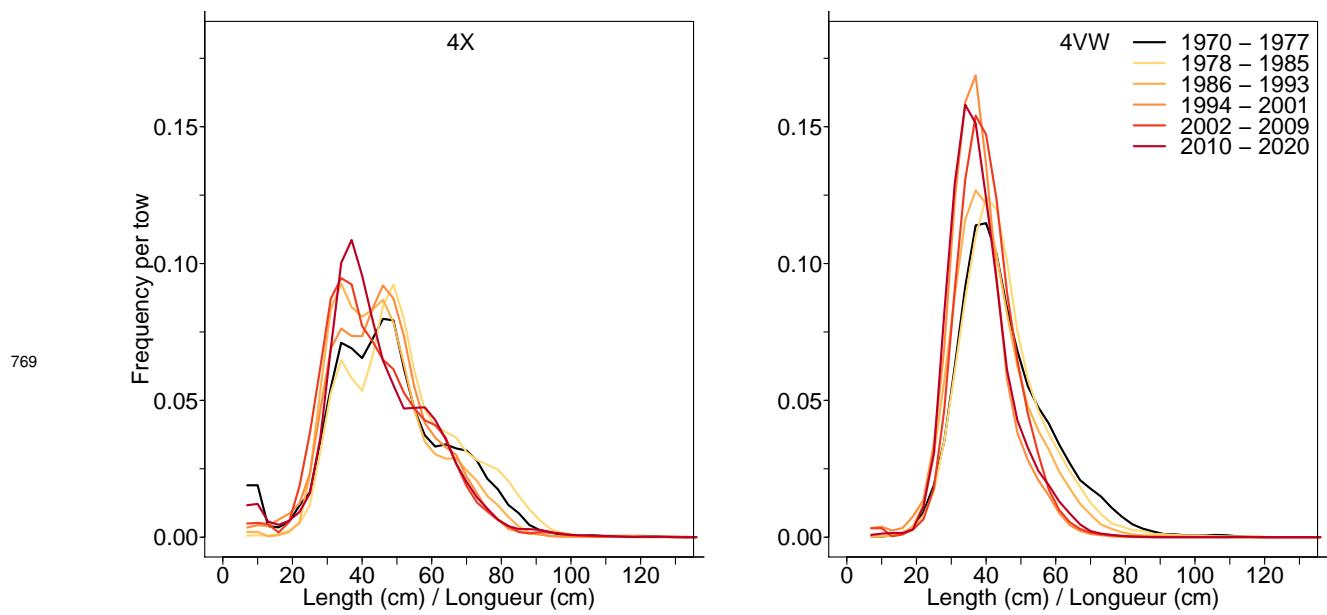


Figure 7.3C. Length frequency distribution in NAFO units 4X and 4VW for White hake.

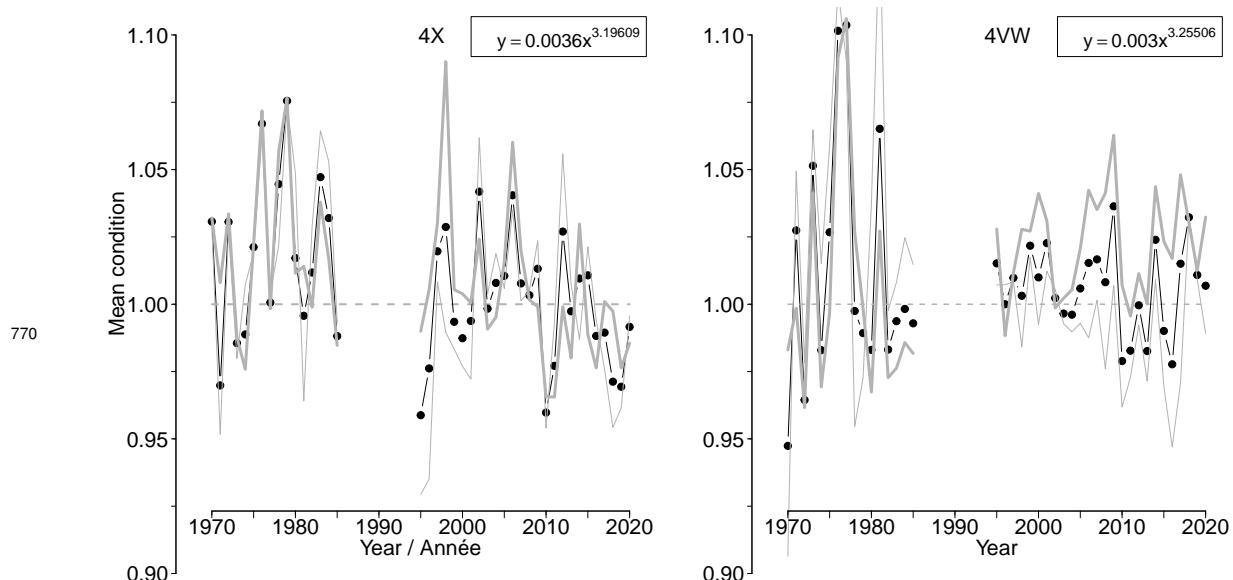
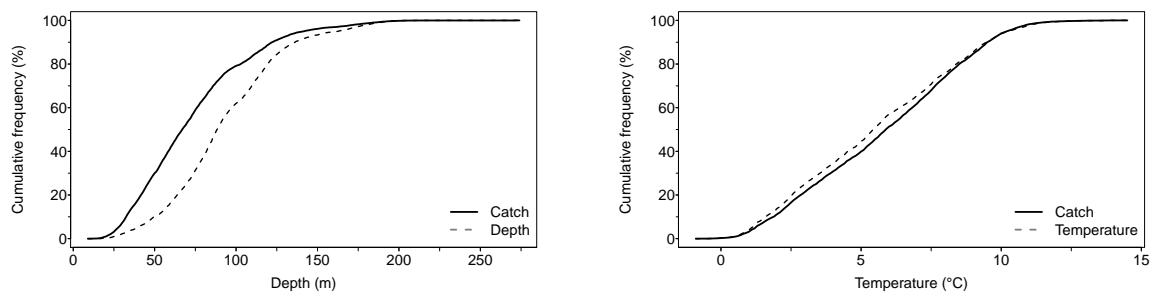
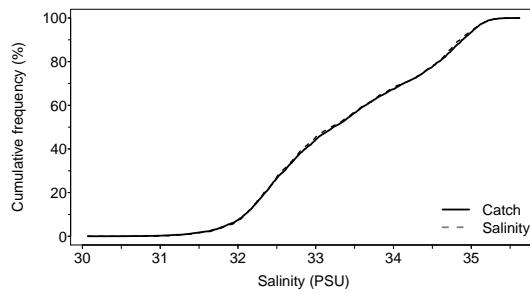


Figure 7.3D. Average fish condition in NAFO units 4X and 4VW for White hake.



771



Freq	Depth	Temp	Sal
F5	40	1.1	31.00
F25	70	3.0	32.46
F50	89	5.5	33.20
F75	115	7.9	34.39
F95	163	10.0	35.04

Figure 7.3E. Catch distribution by depth, temperature and salinity of White hake.

772

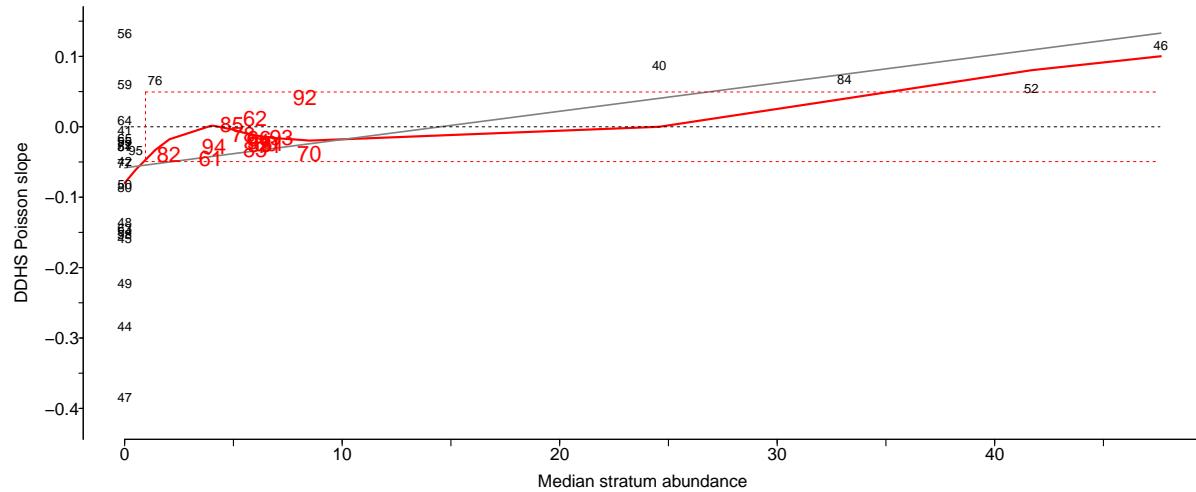


Figure 7.3F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for White hake.

773

7.4 Red hake (Merluche écureuil) - species code 13 (category LF)

774

Scientific name: [Urophycis chuss](#)

775

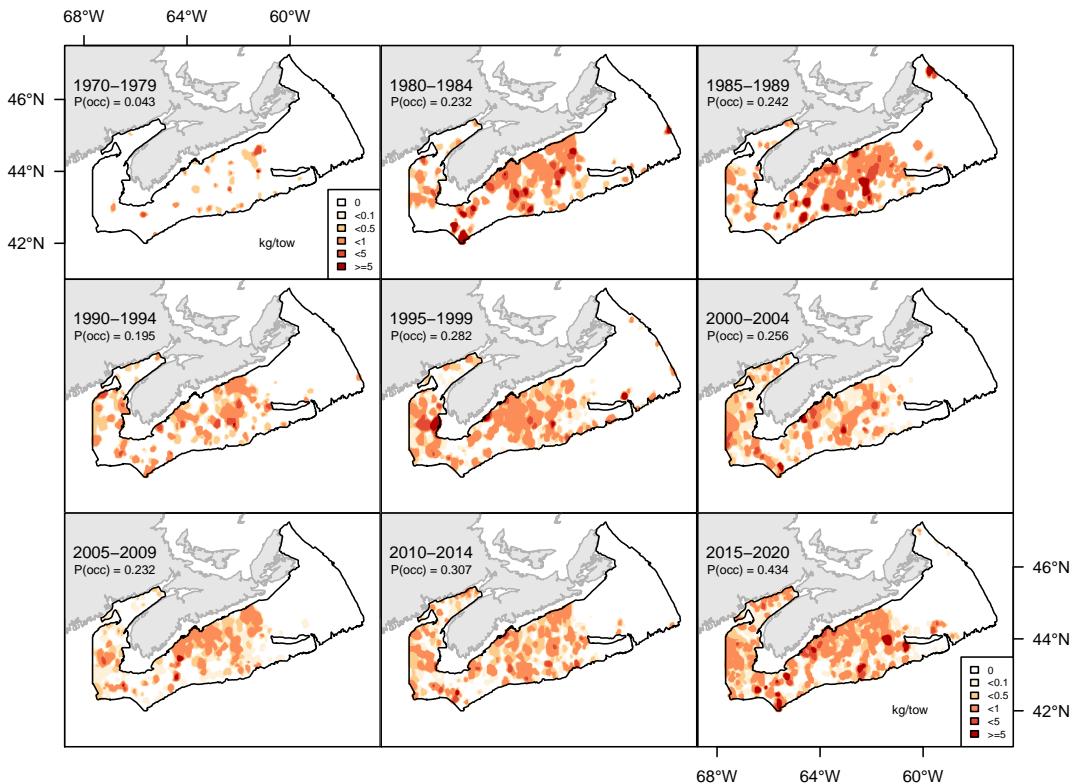


Figure 7.4A. Inverse distance weighted distribution of catch biomass (kg/tow) for Red hake.

776

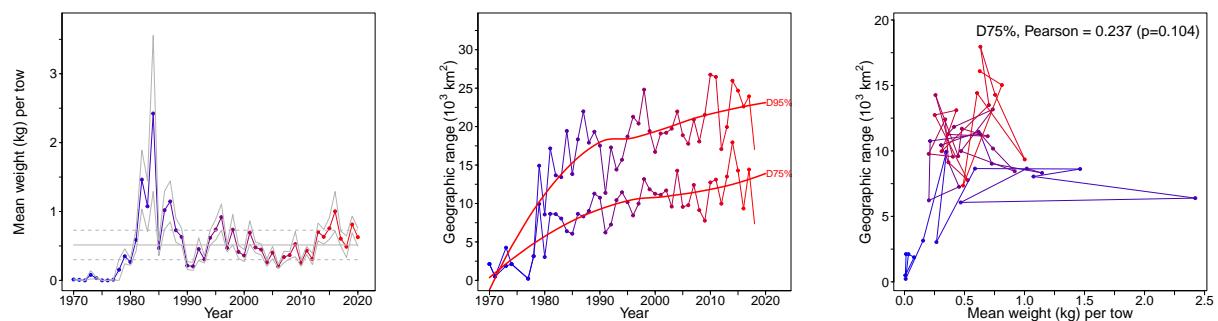


Figure 7.4B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Red hake.

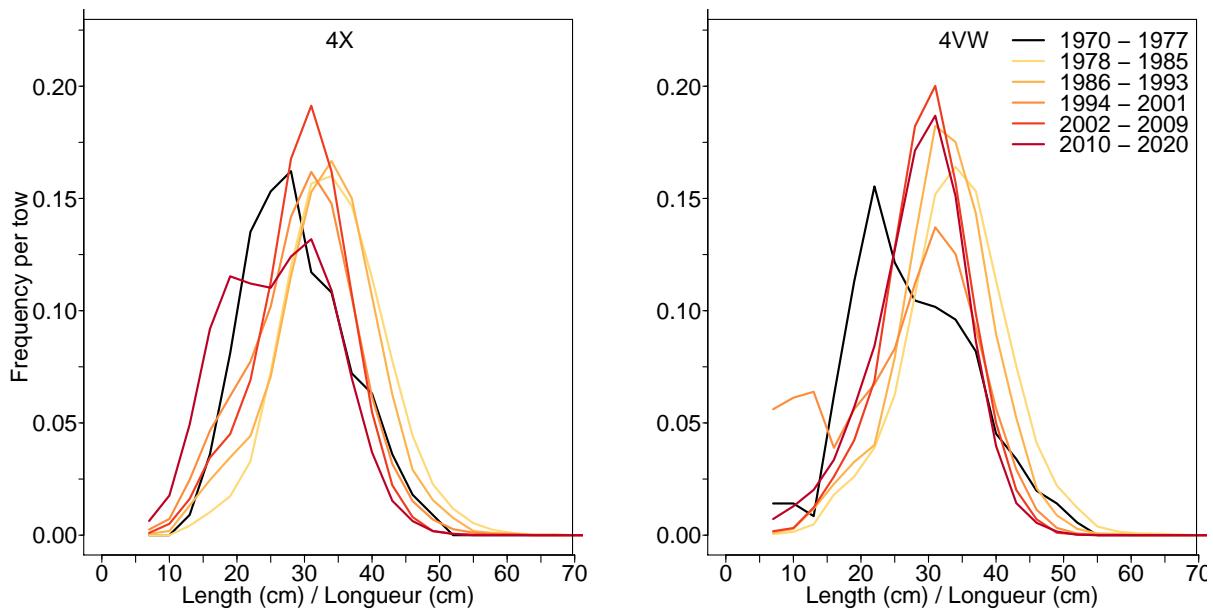


Figure 7.4C. Length frequency distribution in NAFO units 4X and 4VW for Red hake.

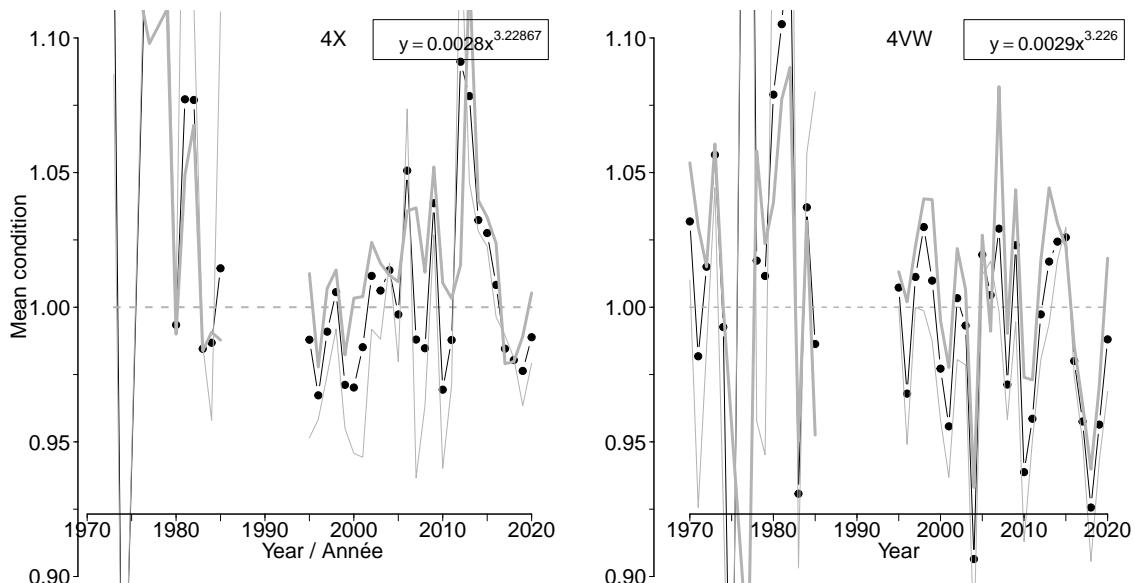
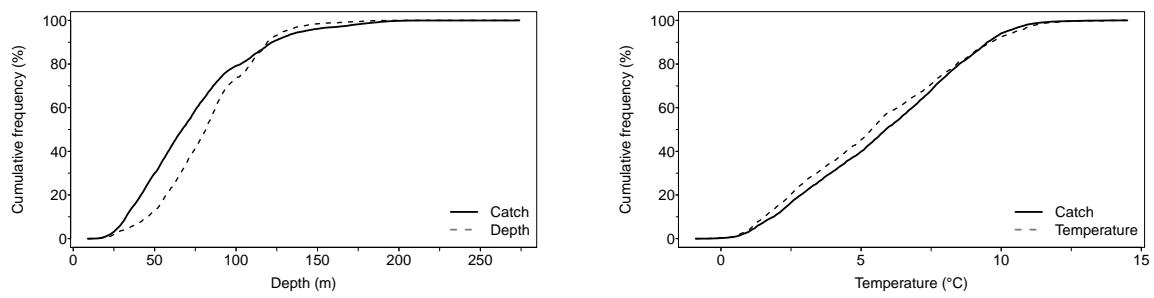
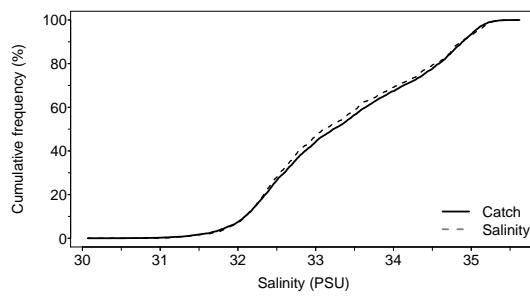


Figure 7.4D. Average fish condition in NAFO units 4X and 4VW for Red hake.



779



Freq	Depth	Temp	Sal
F5	35	1.1	31.00
F25	62	2.9	32.43
F50	82	5.4	33.12
F75	103	7.9	34.32
F95	130	10.0	35.08

Figure 7.4E. Catch distribution by depth, temperature and salinity of Red hake.

780

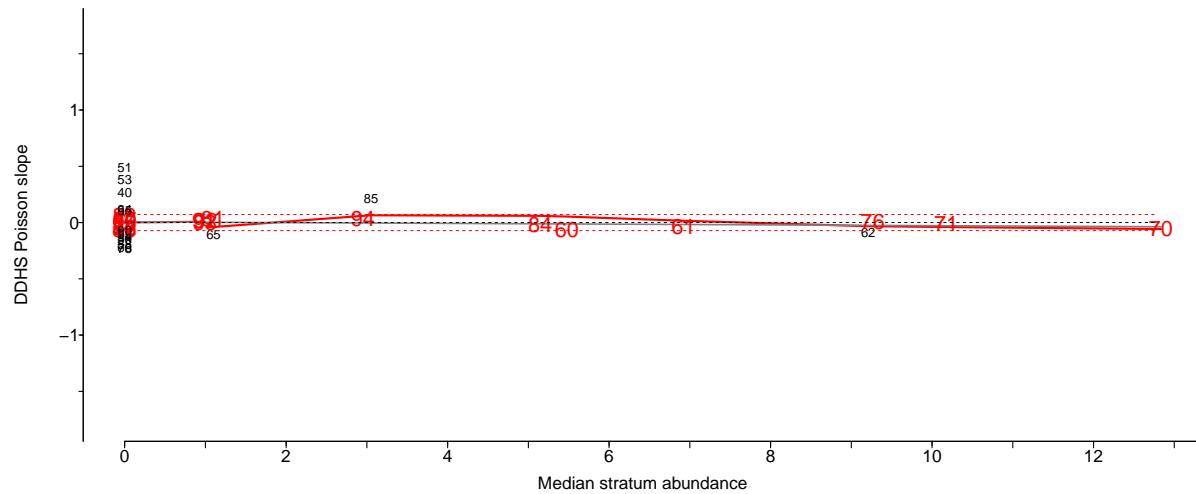


Figure 7.4F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Red hake.

781

7.5 Silver hake (*Merlu argenté*) - species code 14 (category LF)

782

Scientific name: [Merluccius bilinearis](#)

783

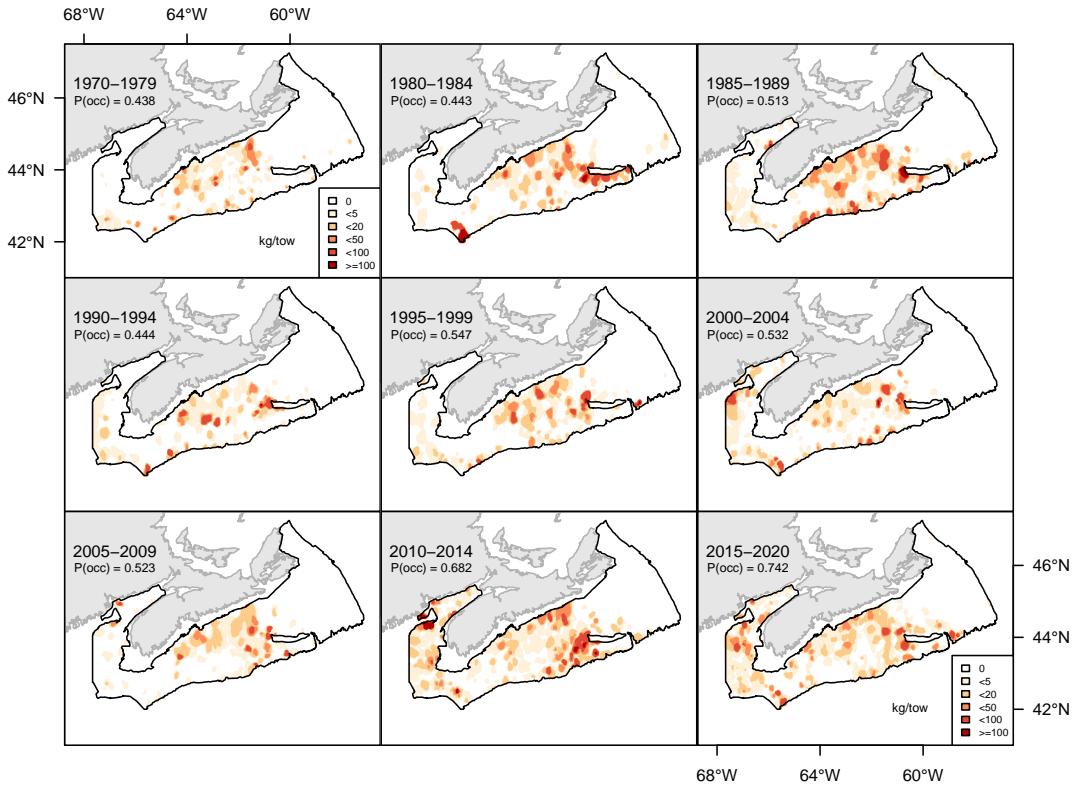


Figure 7.5A. Inverse distance weighted distribution of catch biomass (kg/tow) for Silver hake.

784

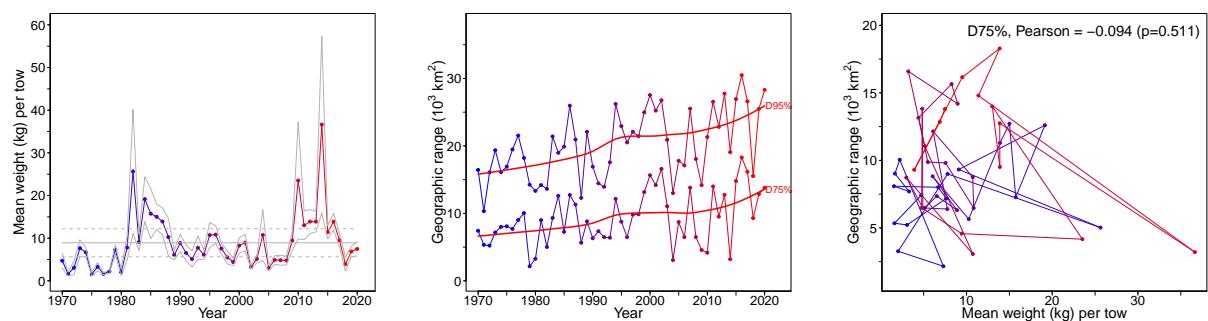


Figure 7.5B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Silver hake.

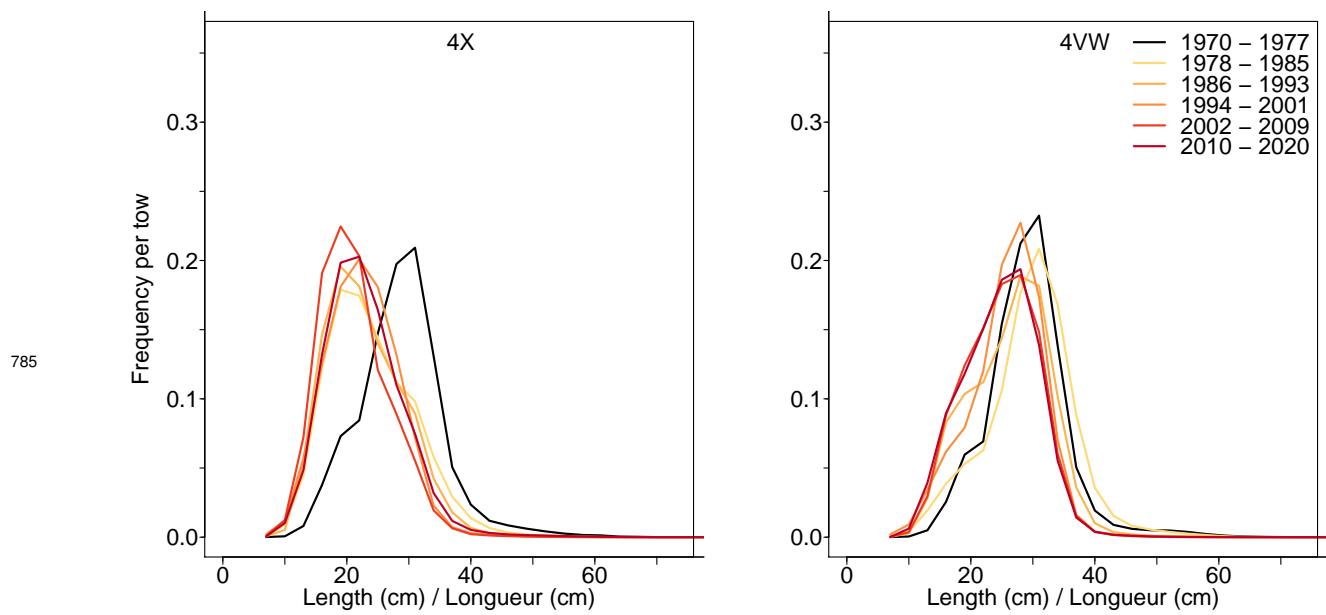


Figure 7.5C. Length frequency distribution in NAFO units 4X and 4VW for Silver hake.

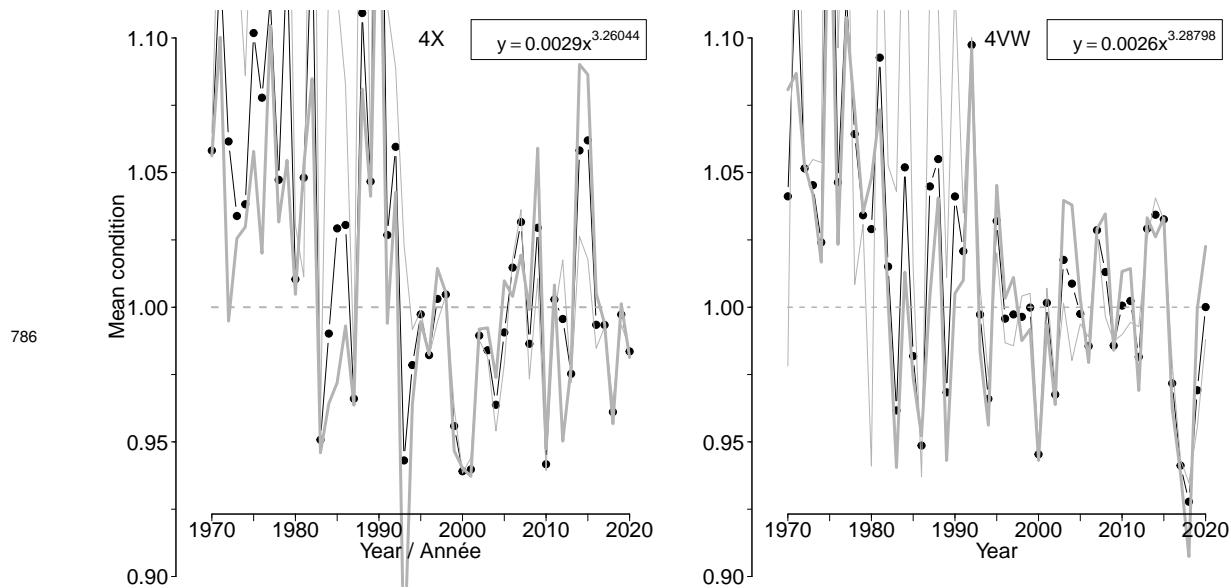
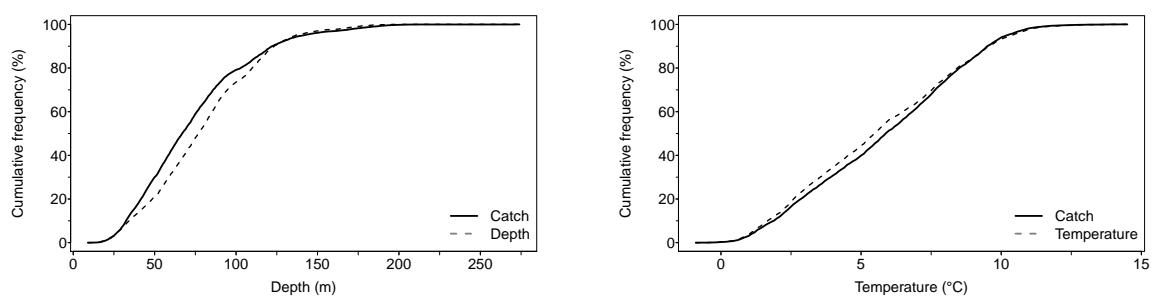
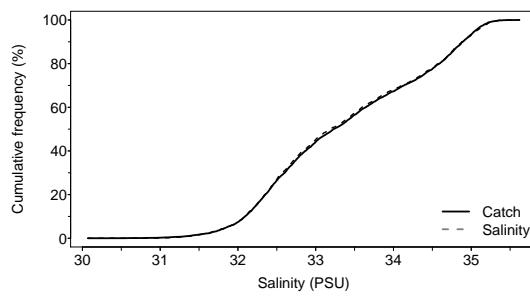


Figure 7.5D. Average fish condition in NAFO units 4X and 4VW for Silver hake.



787



Freq	Depth	Temp	Sal
F5	28	1.2	31.00
F25	55	3.1	32.46
F50	77	5.5	33.20
F75	104	8.0	34.37
F95	137	10.0	35.07

Figure 7.5E. Catch distribution by depth, temperature and salinity of Silver hake.

788

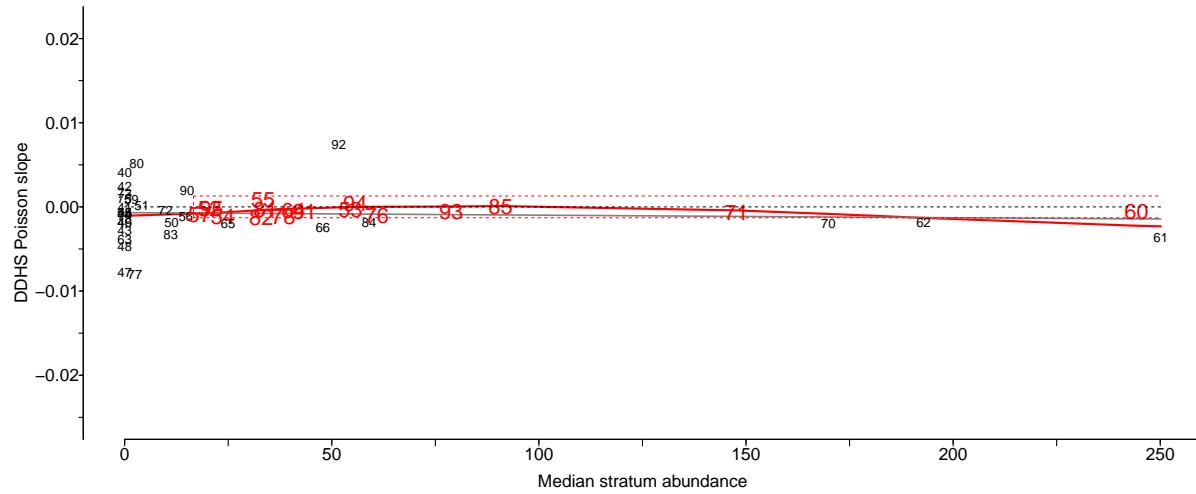


Figure 7.5F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Silver hake.

789

7.6 Pollock (Goberge) - species code 16 (category LF)

790

Scientific name: [Pollachius virens](#)

791

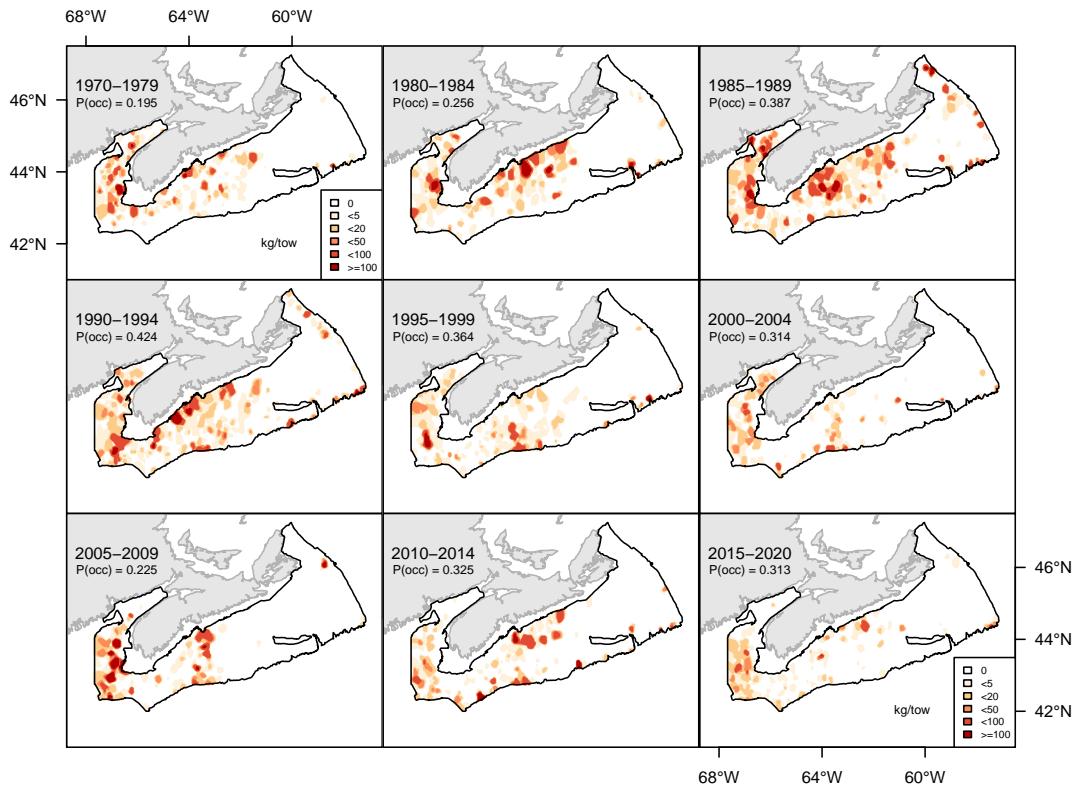


Figure 7.6A. Inverse distance weighted distribution of catch biomass (kg/tow) for Pollock.

792

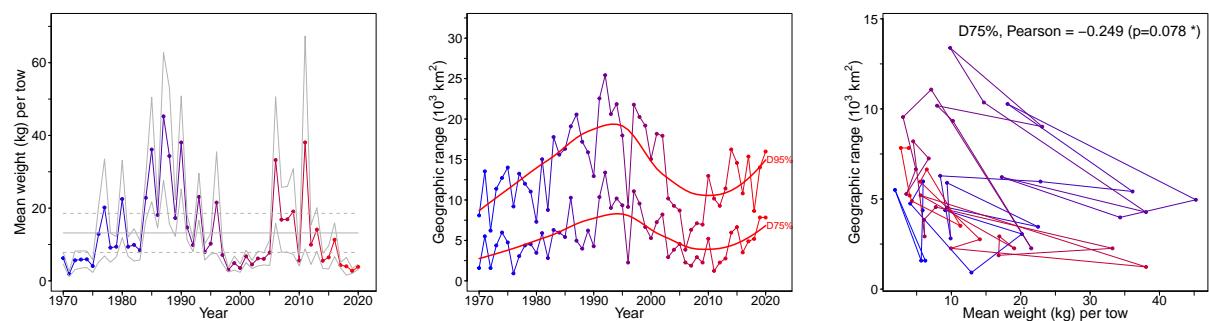


Figure 7.6B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Pollock.

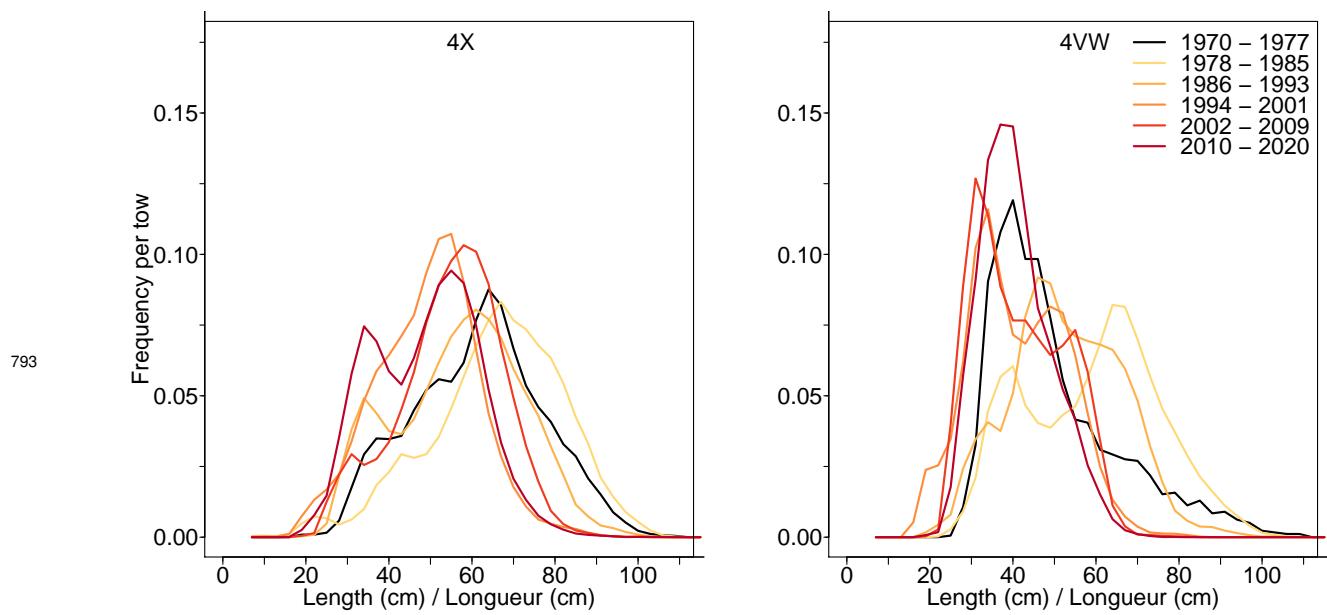


Figure 7.6C. Length frequency distribution in NAFO units 4X and 4VW for Pollock.

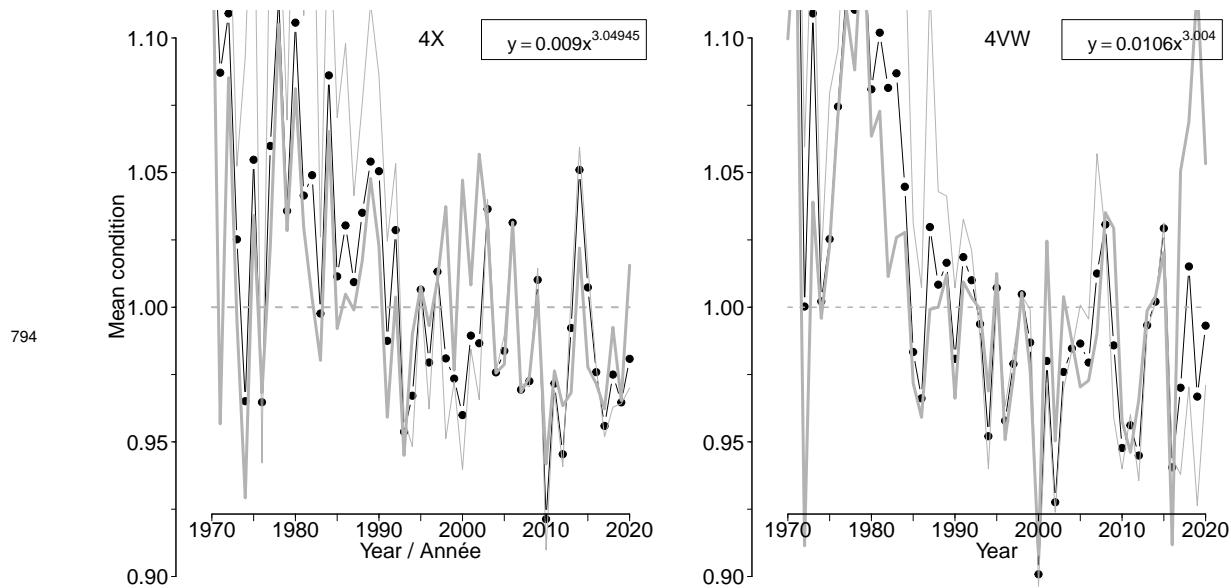
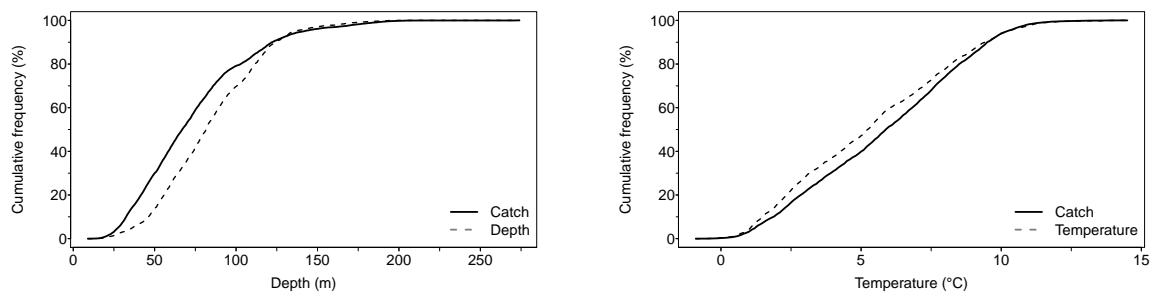
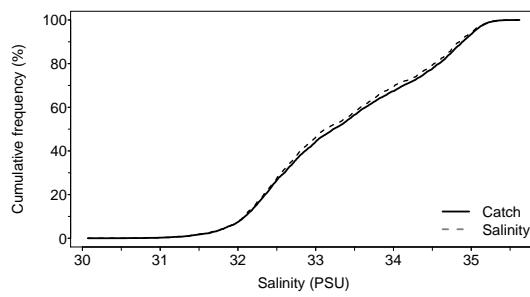


Figure 7.6D. Average fish condition in NAFO units 4X and 4VW for Pollock.



795



Freq	Depth	Temp	Sal
F5	37	1.1	31.00
F25	60	2.8	32.45
F50	82	5.3	33.14
F75	108	7.7	34.33
F95	137	10.0	35.03

Figure 7.6E. Catch distribution by depth, temperature and salinity of Pollock.

796

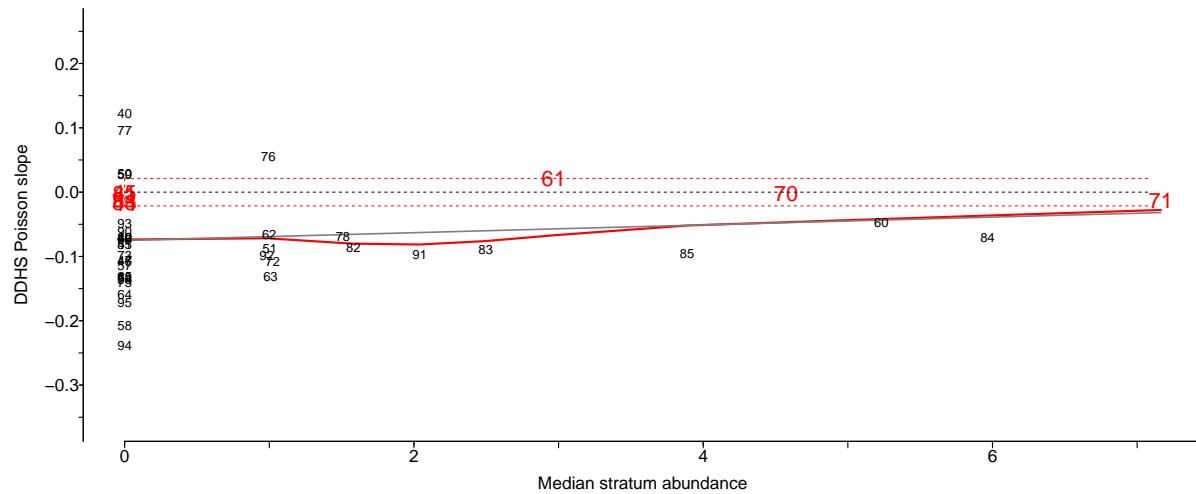


Figure 7.6F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Pollock.

797

7.7 Atlantic redfishes (Sébastes de l'Atlantique) - species code 23 (category LF)

798

Scientific name: [Sebastes](#)

799

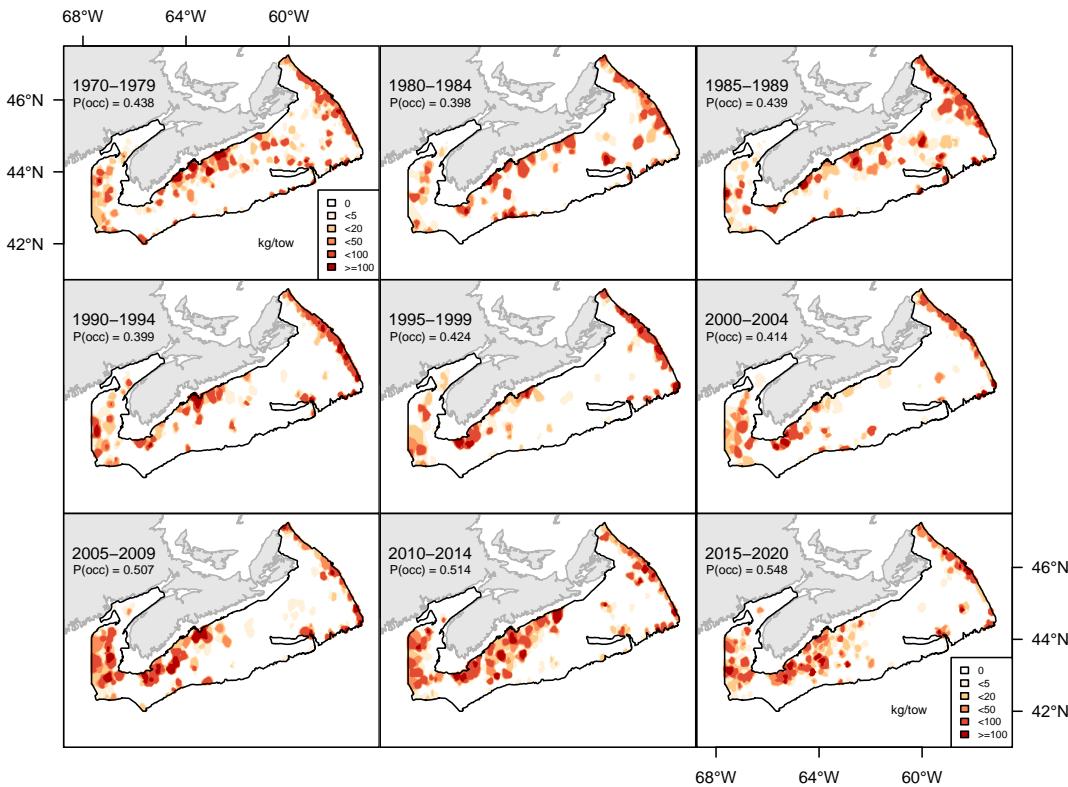


Figure 7.7A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic redfishes.

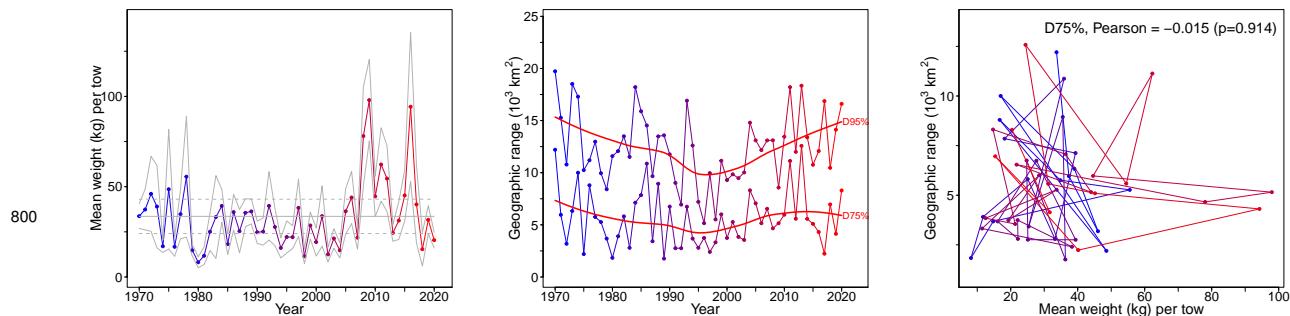


Figure 7.7B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic redfishes.

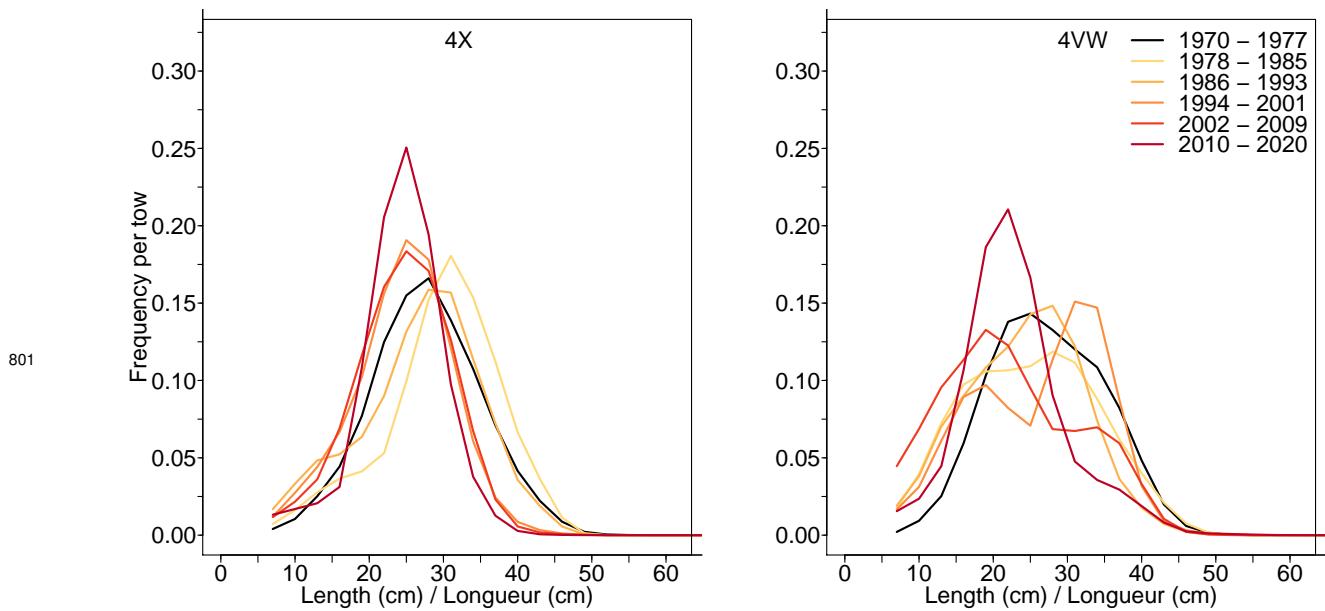


Figure 7.7C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic redfishes.

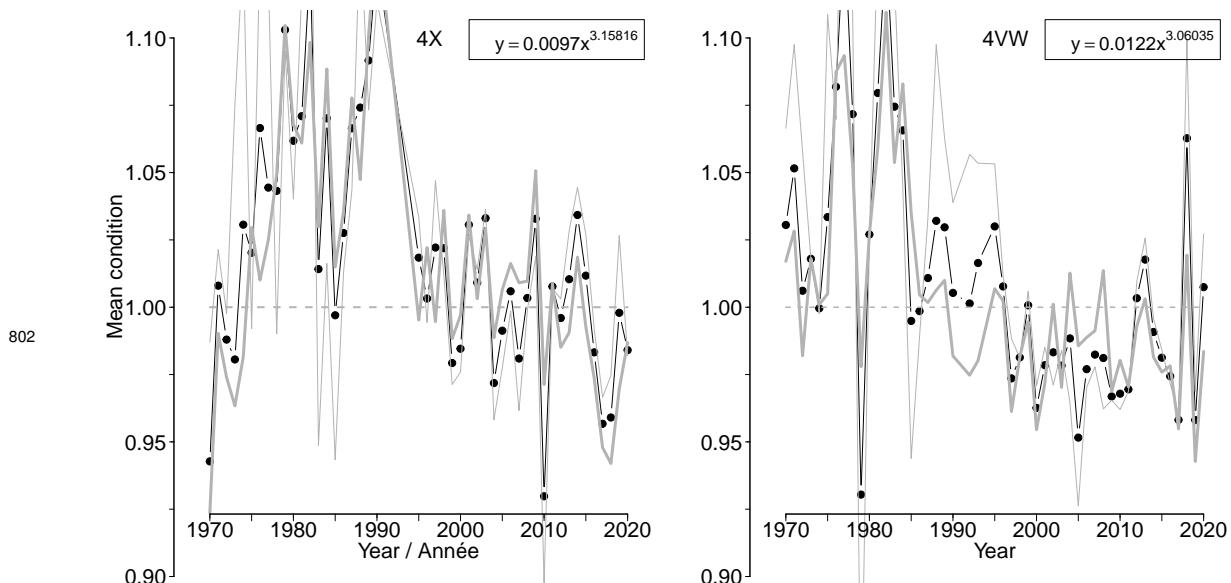
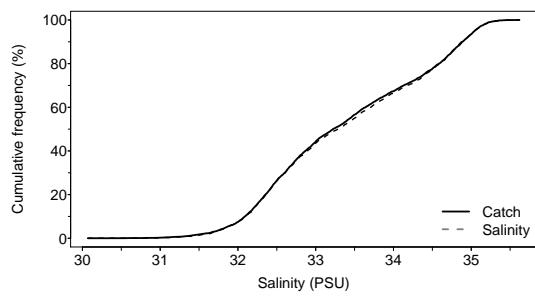
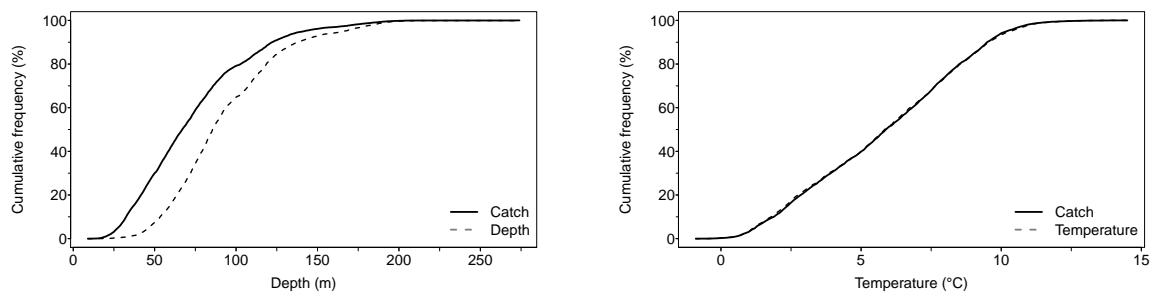


Figure 7.7D. Average fish condition in NAFO units 4X and 4VW for Atlantic redfishes.



Freq	Depth	Temp	Sal
F5	47	1.2	31.00
F25	68	3.4	32.48
F50	86	5.9	33.29
F75	114	8.1	34.41
F95	166	10.0	35.05

Figure 7.7E. Catch distribution by depth, temperature and salinity of Atlantic redfishes.

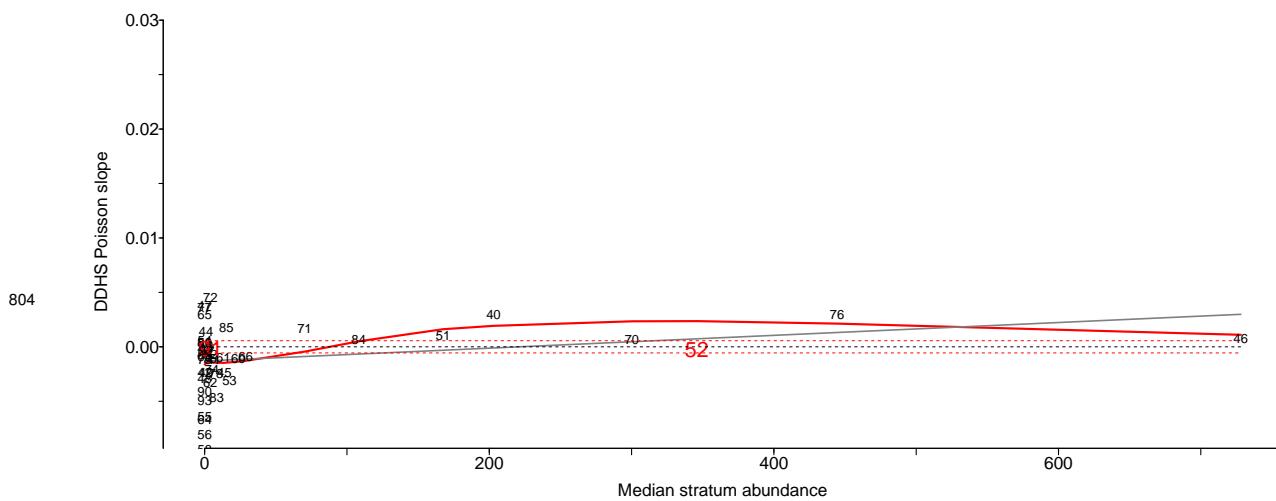


Figure 7.7F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic redfishes.

805 **7.8 Longhorn sculpin (Chabosseau à dix-huit épines) - species code 300 (category**
 806 **LF)**

807 Scientific name: [Myoxocephalus octodecemspiniferus](#)

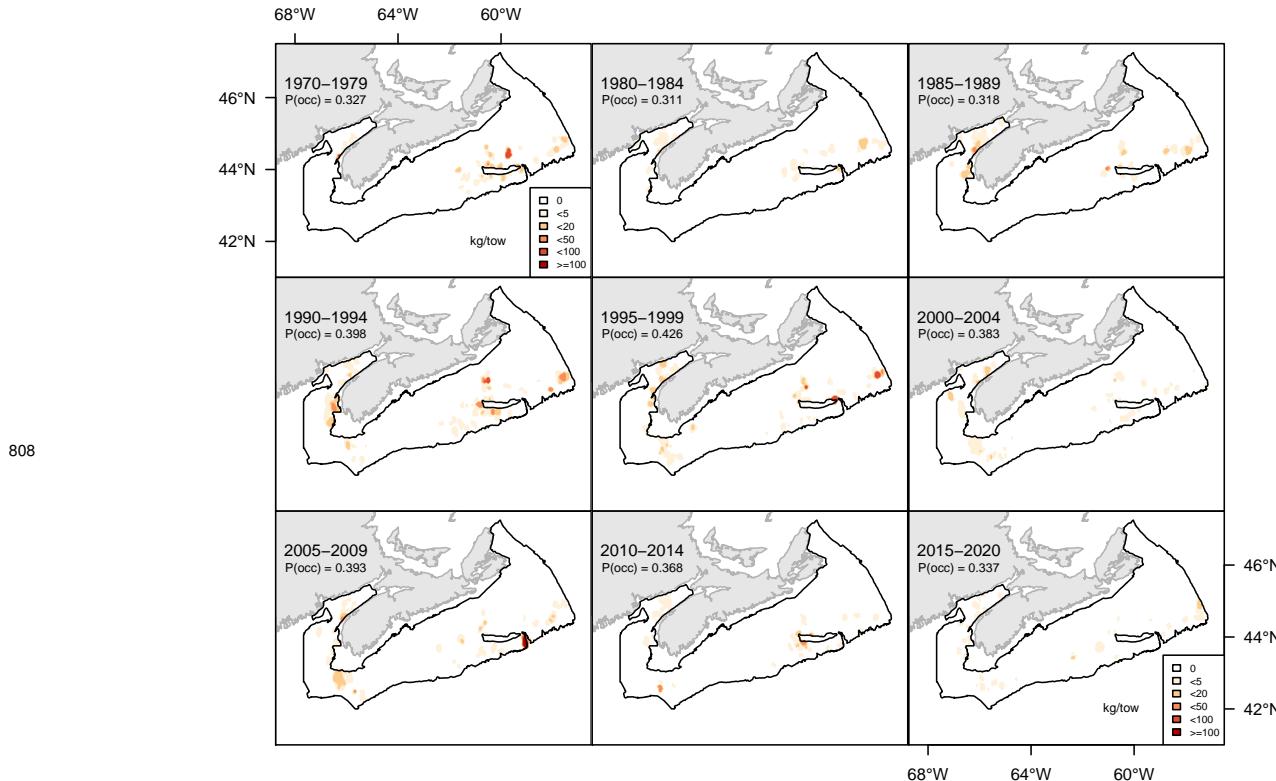


Figure 7.8A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longhorn sculpin.

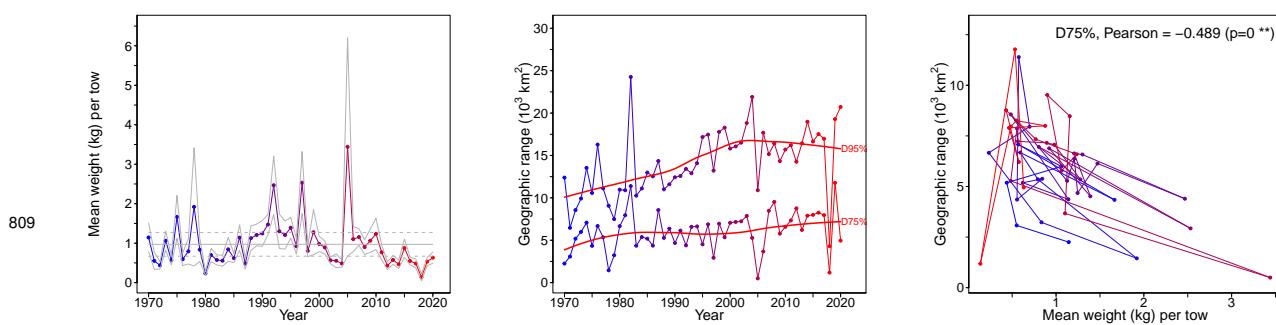


Figure 7.8B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longhorn sculpin.

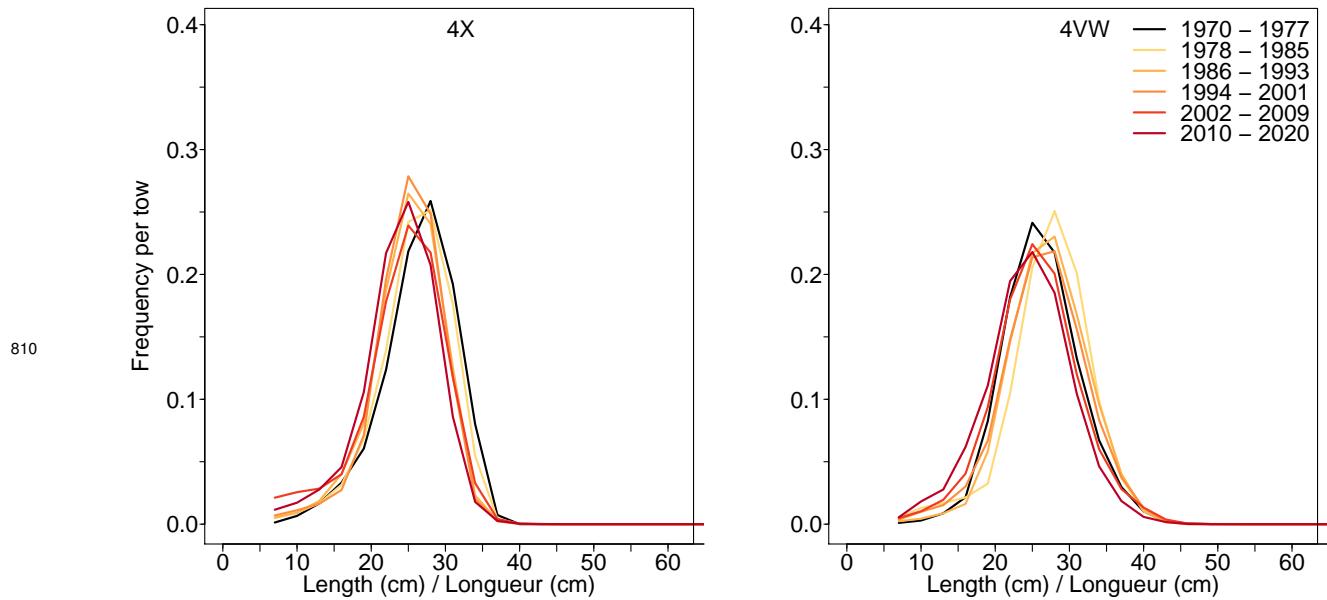


Figure 7.8C. Length frequency distribution in NAFO units 4X and 4VW for Longhorn sculpin.

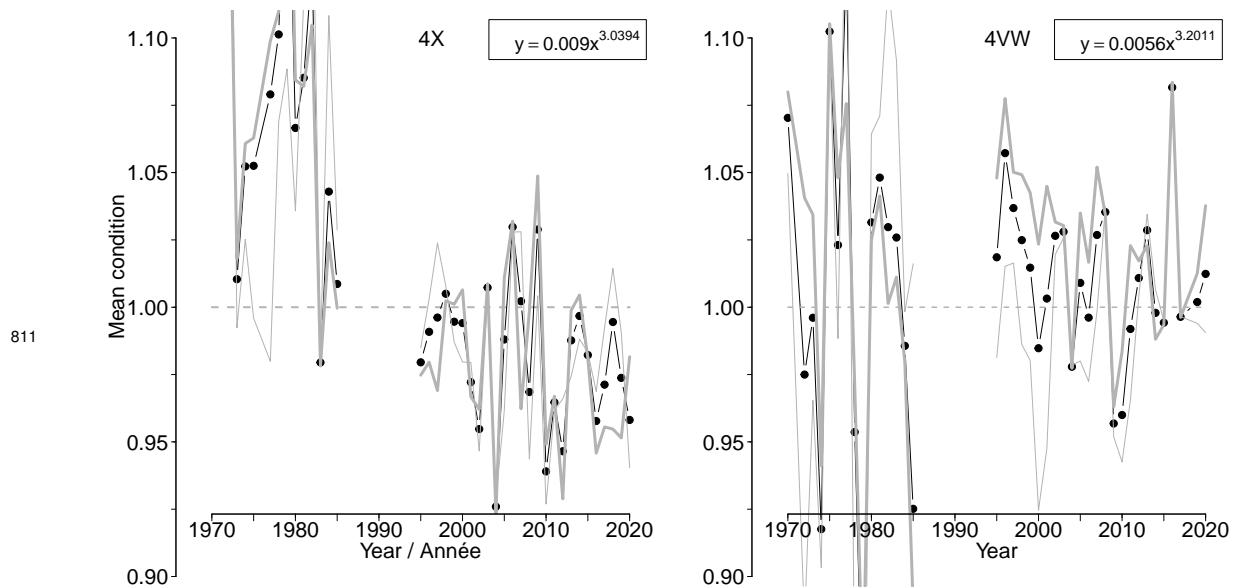
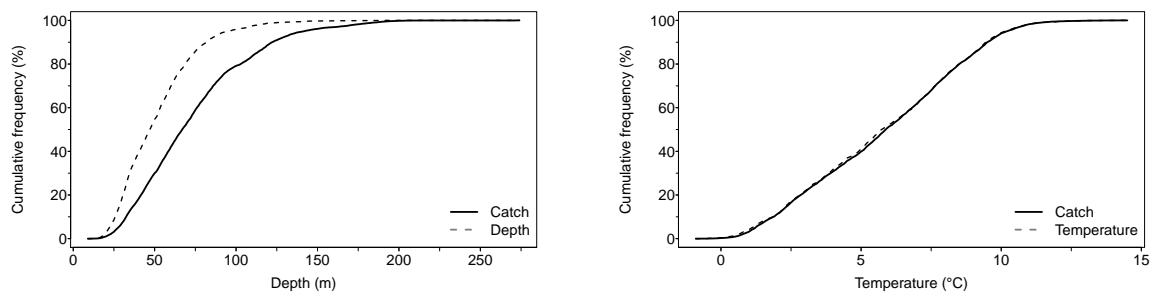
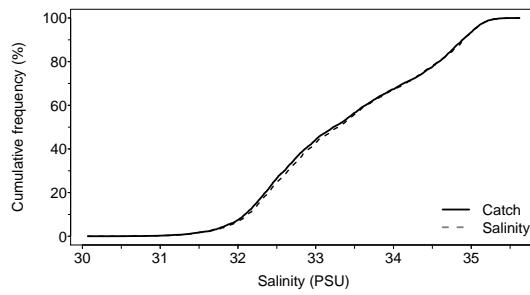


Figure 7.8D. Average fish condition in NAFO units 4X and 4VW for Longhorn sculpin.



812



Freq	Depth	Temp	Sal
F5	23	1.2	31.00
F25	33	3.3	32.51
F50	48	5.8	33.29
F75	64	8.1	34.38
F95	96	10.0	35.05

Figure 7.8E. Catch distribution by depth, temperature and salinity of Longhorn sculpin.

813

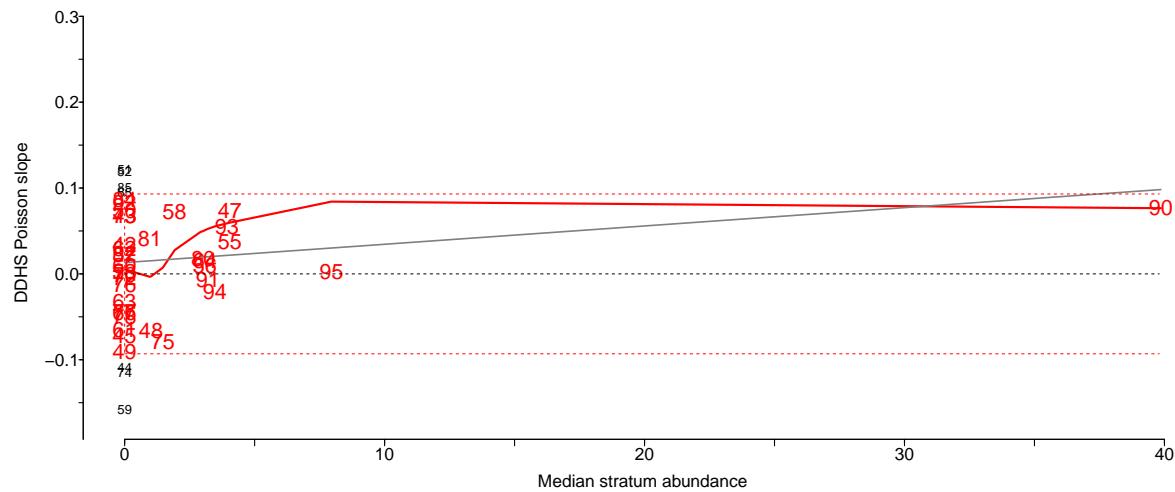


Figure 7.8F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Longhorn sculpin.

814

7.9 Moustache sculpin (Faux-trigle armé) - species code 304 (category LF)

815

Scientific name: [Triglops murrayi](#)

816

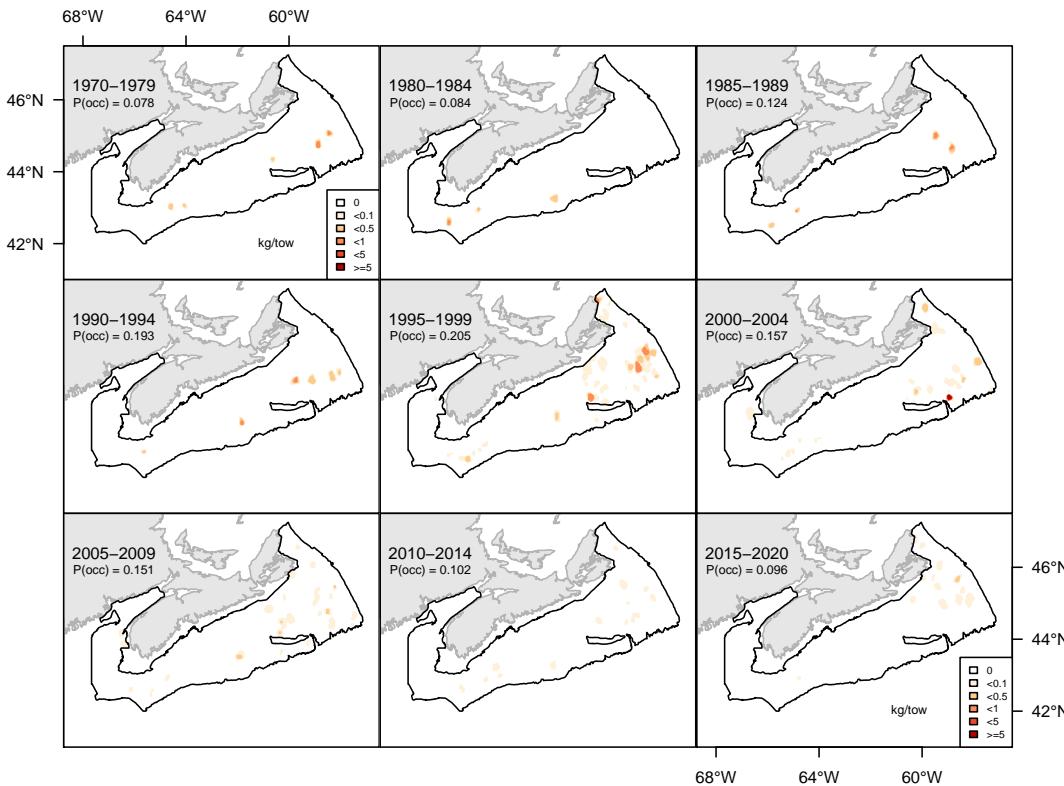


Figure 7.9A. Inverse distance weighted distribution of catch biomass (kg/tow) for Moustache sculpin.

817

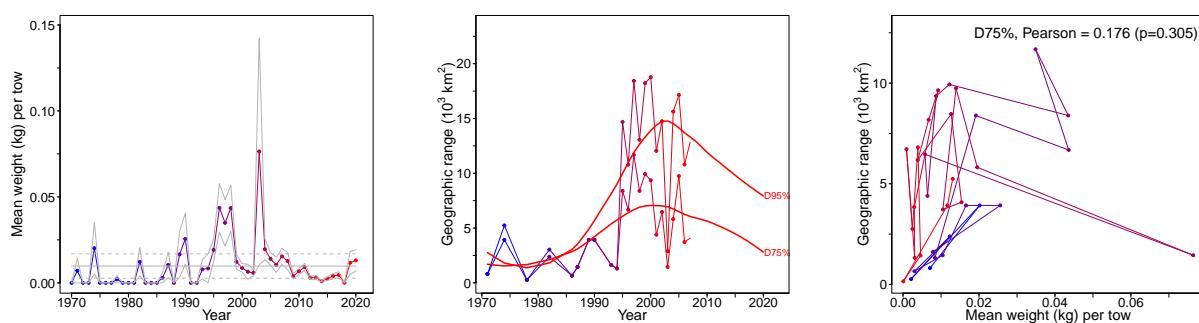


Figure 7.9B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Moustache sculpin.

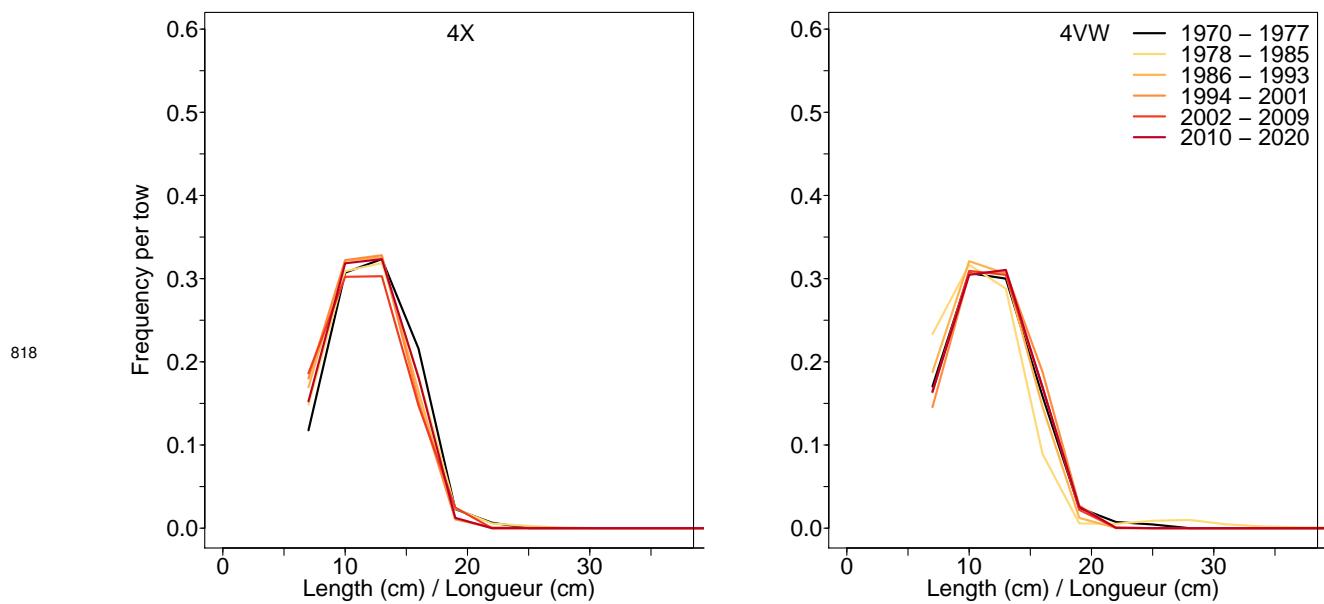


Figure 7.9C. Length frequency distribution in NAFO units 4X and 4VW for Moustache sculpin.

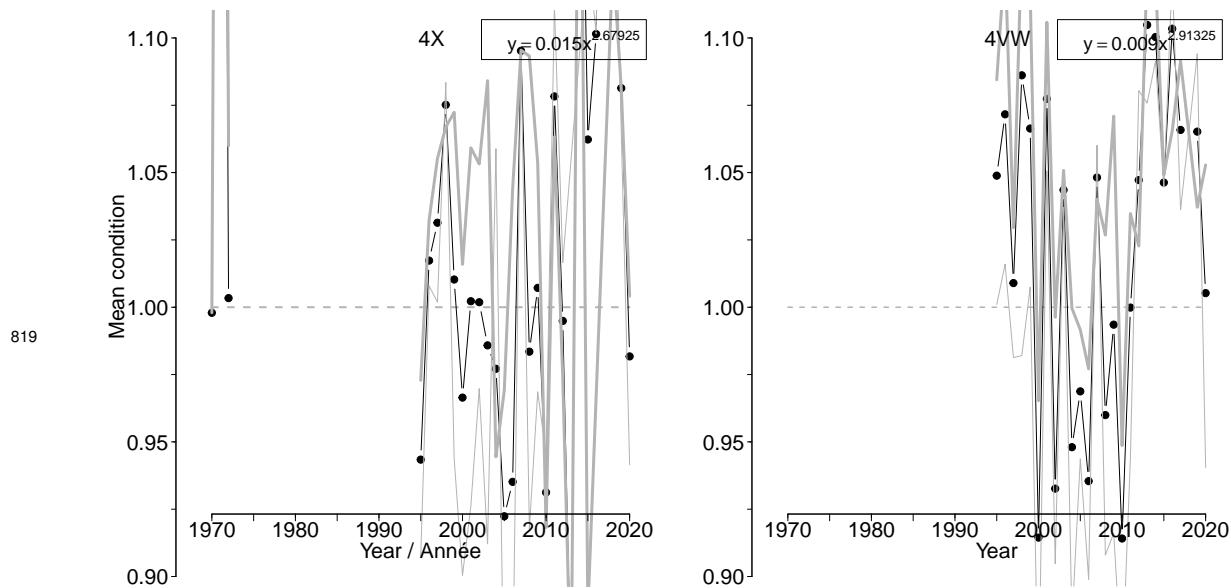
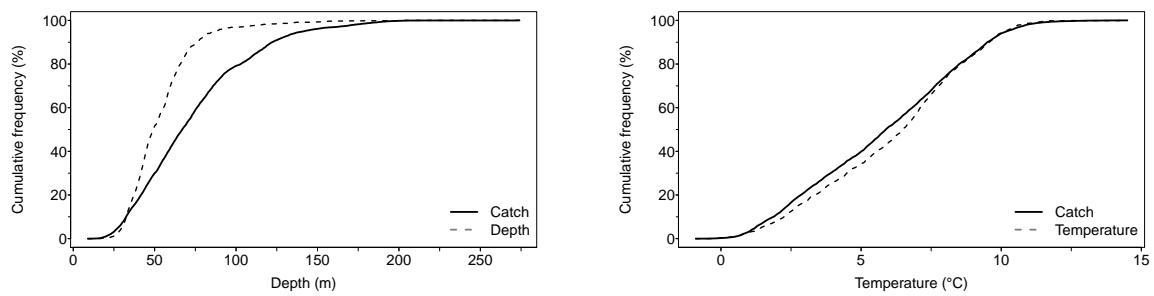
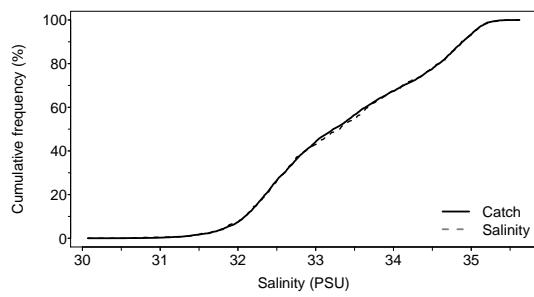


Figure 7.9D. Average fish condition in NAFO units 4X and 4VW for Moustache sculpin.



820



Freq	Depth	Temp	Sal
F5	30	1.5	31.00
F25	40	4.0	32.48
F50	50	6.5	33.31
F75	63	8.2	34.39
F95	88	10.0	35.06

Figure 7.9E. Catch distribution by depth, temperature and salinity of Moustache sculpin.

821

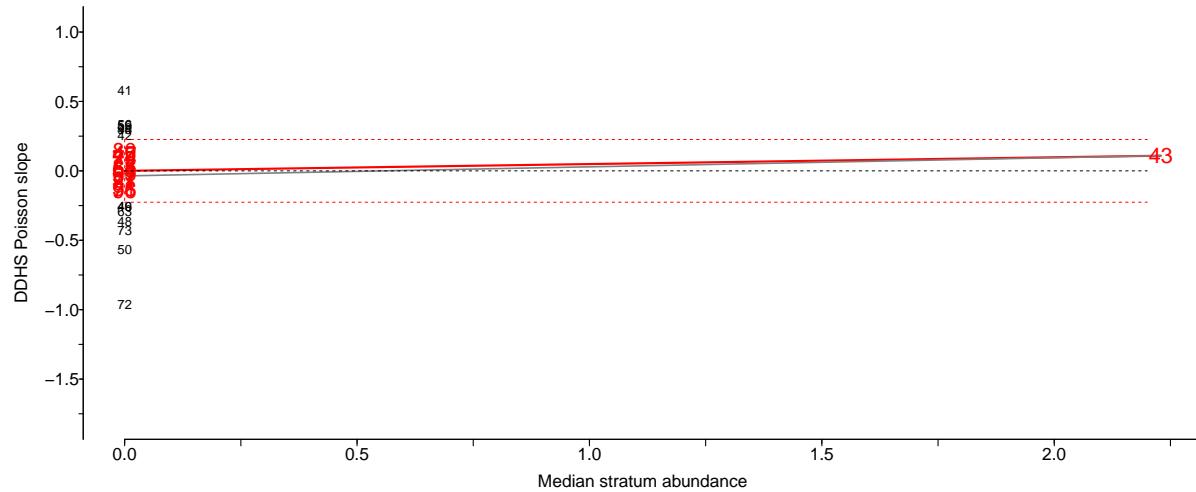


Figure 7.9F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Moustache sculpin.

822 **7.10 Sea raven (Hémithriptère atlantique) - species code 320 (category LF)**

823 Scientific name: [Hemitripterus americanus](#)

824

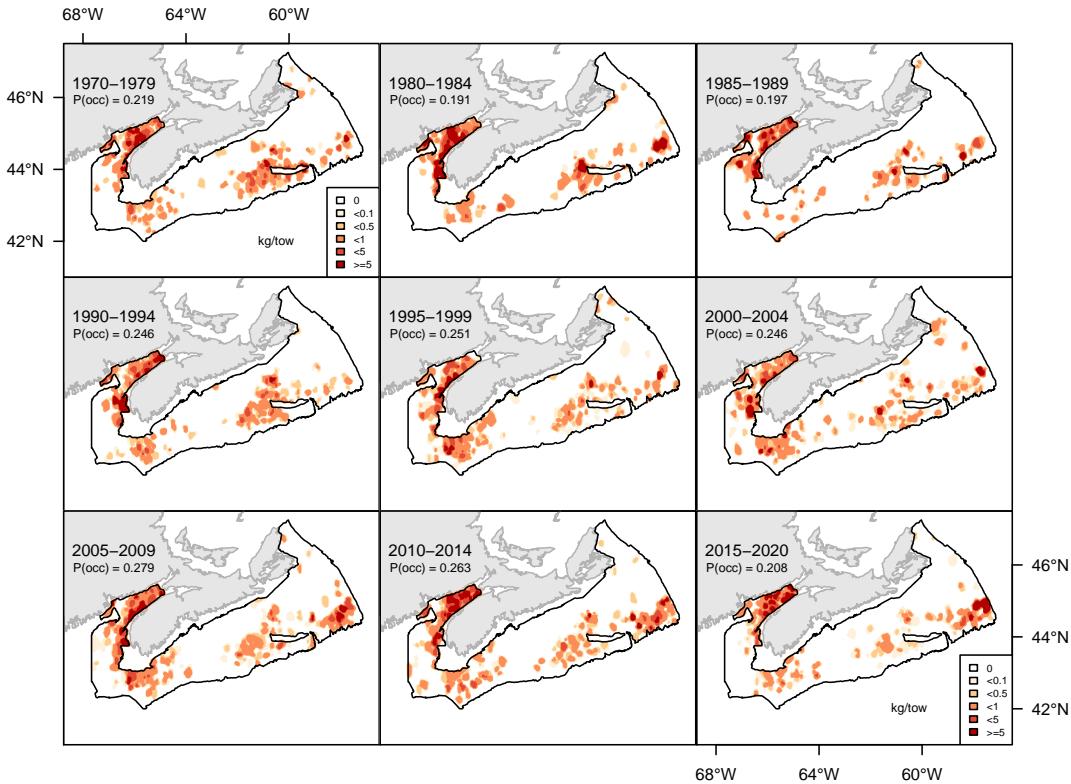


Figure 7.10A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sea raven.

825

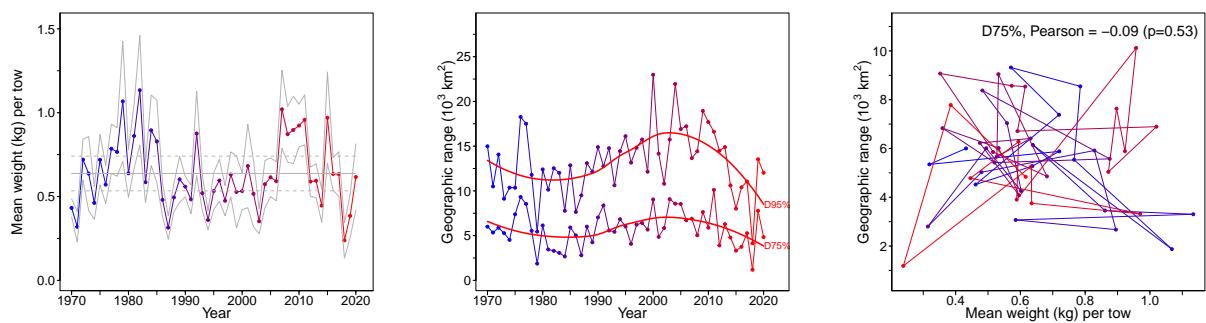


Figure 7.10B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sea raven.

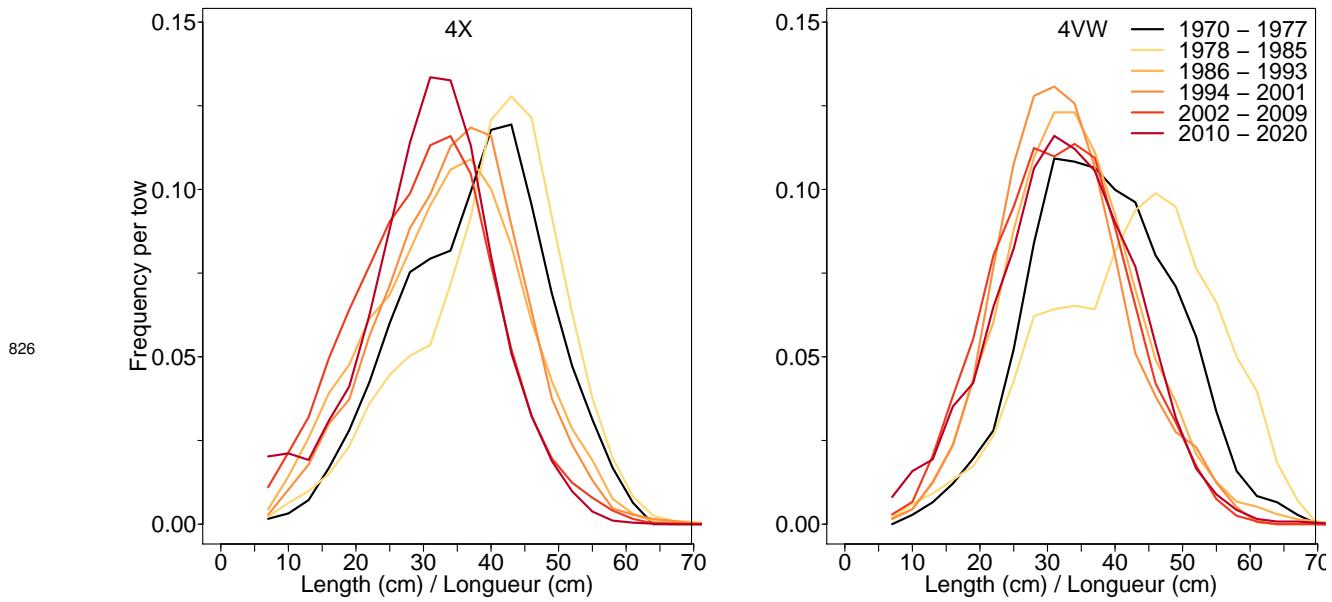


Figure 7.10C. Length frequency distribution in NAFO units 4X and 4VW for Sea raven.

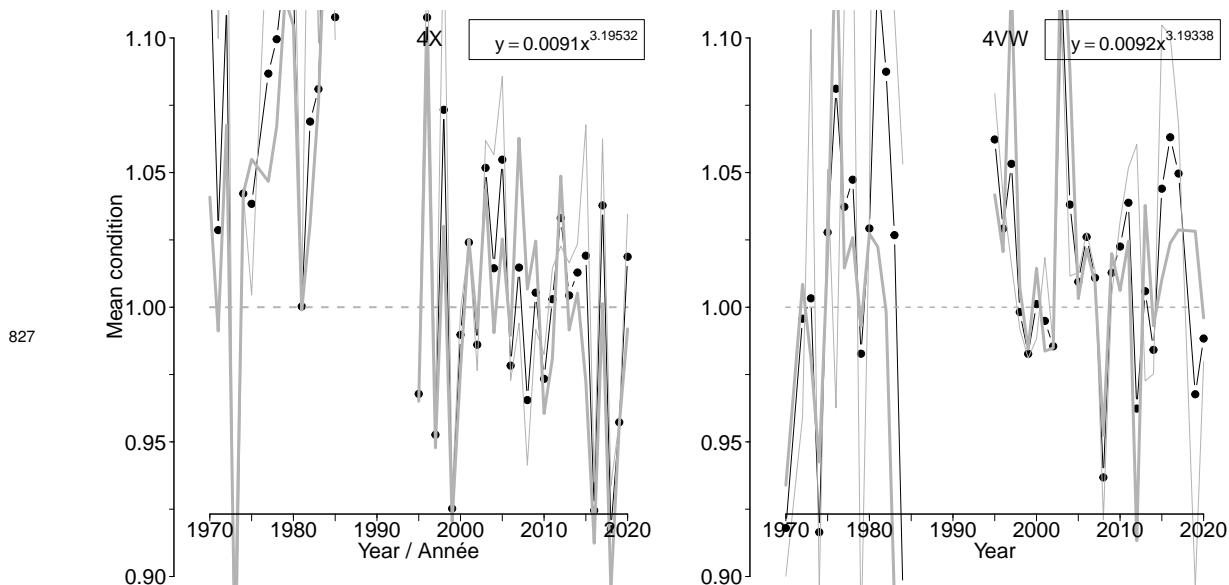
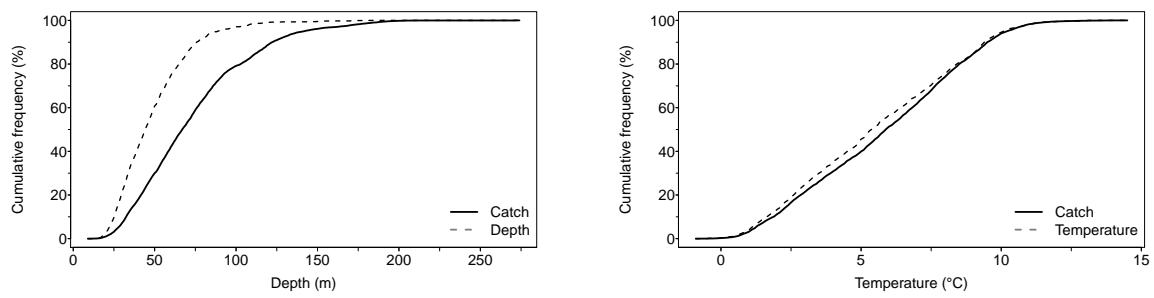
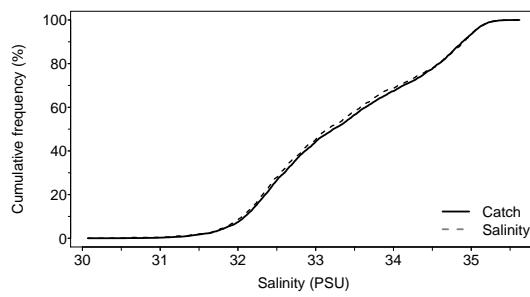


Figure 7.10D. Average fish condition in NAFO units 4X and 4VW for Sea raven.



828



Freq	Depth	Temp	Sal
F5	22	1.1	31.00
F25	32	3.1	32.43
F50	45	5.4	33.15
F75	61	8.0	34.35
F95	89	10.0	35.05

Figure 7.10E. Catch distribution by depth, temperature and salinity of Sea raven.

829

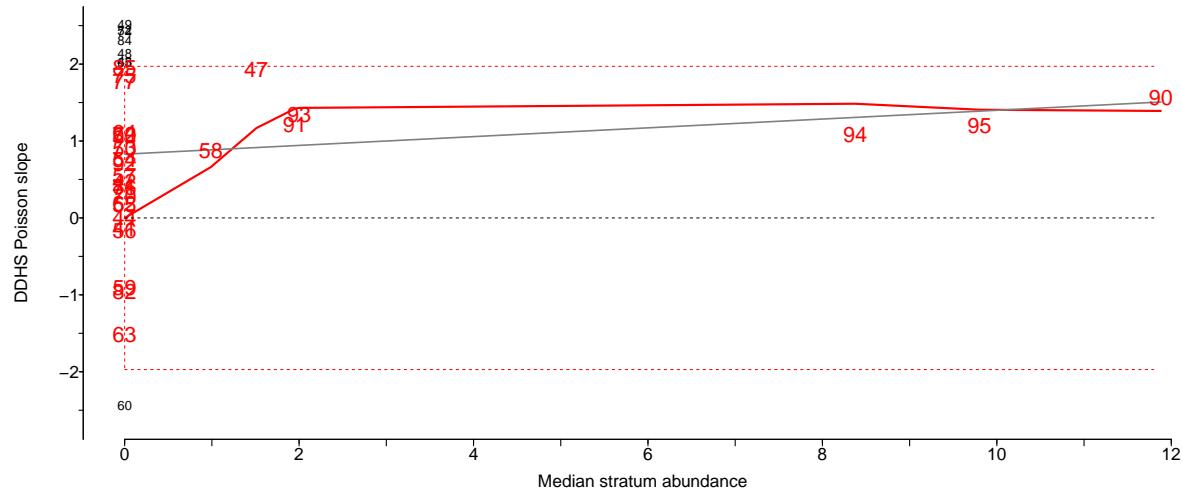


Figure 7.10F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Sea raven.

830 **7.11 Alligatorfish (Poisson-alligator atlantique) - species code 340 (category LF)**

831 Scientific name: [Aspidophoroides monopterygius](#)

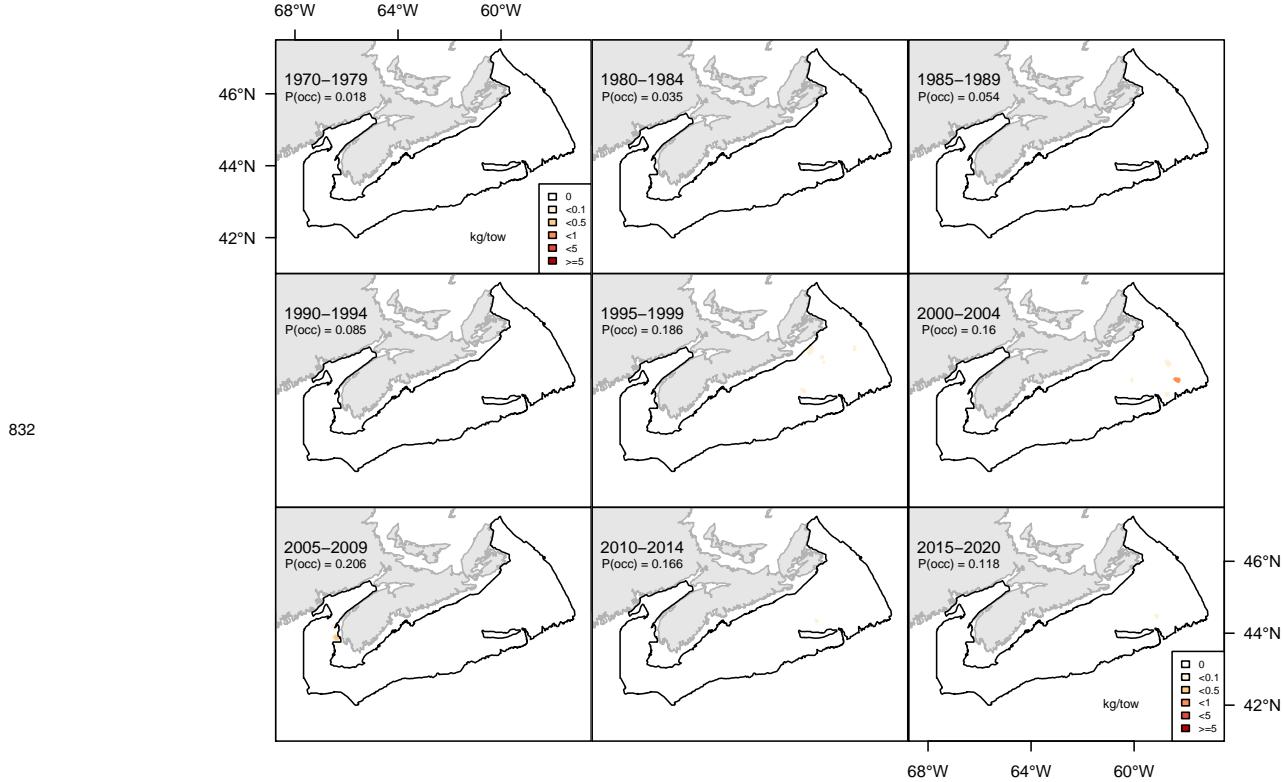


Figure 7.11A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alligatorfish.

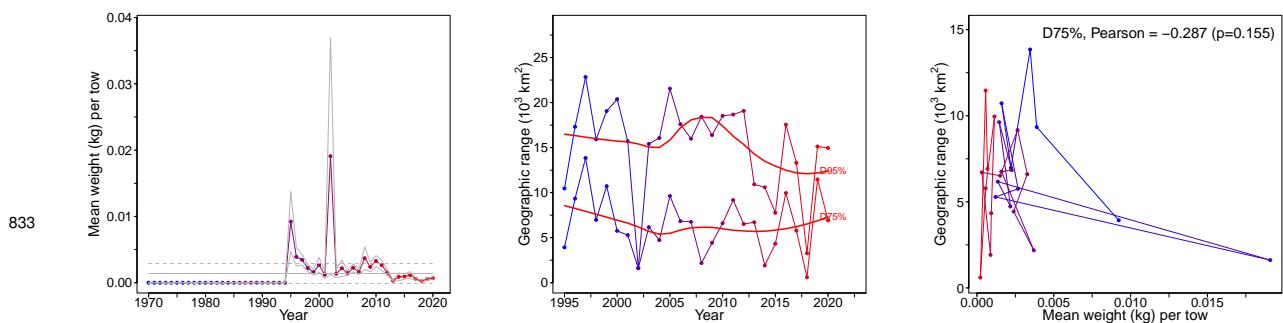


Figure 7.11B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alligatorfish.

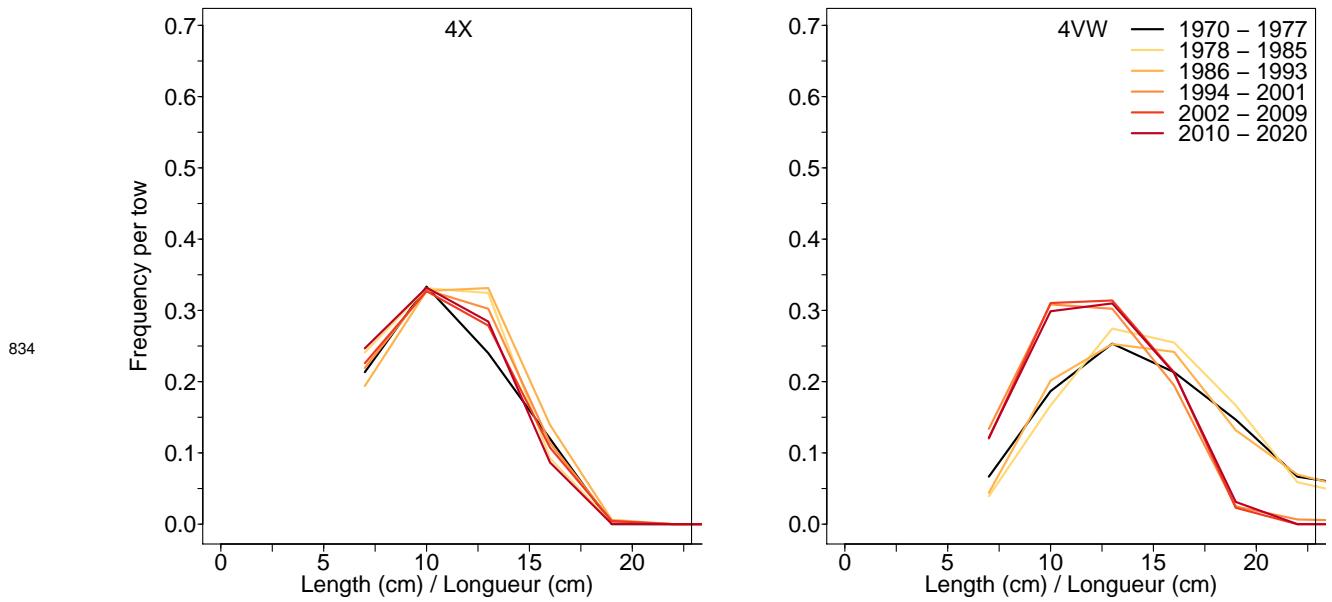


Figure 7.11C. Length frequency distribution in NAFO units 4X and 4VW for Alligatorfish.

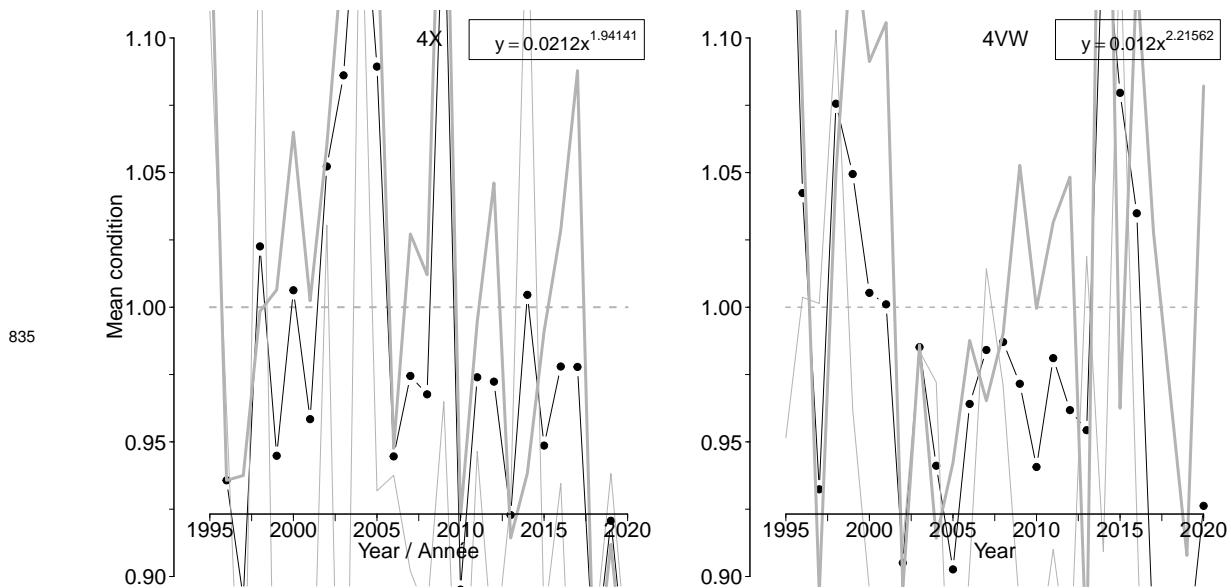
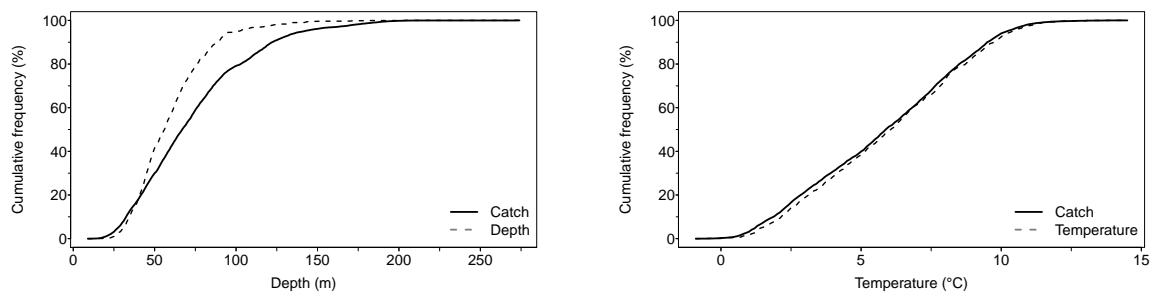
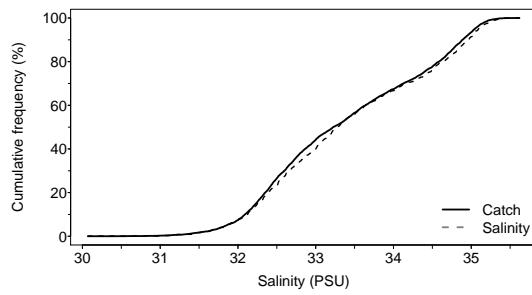


Figure 7.11D. Average fish condition in NAFO units 4X and 4VW for Alligatorfish.



836



Freq	Depth	Temp	Sal
F5	32	1.5	31.00
F25	44	3.7	32.53
F50	57	6.1	33.28
F75	72	8.2	34.45
F95	102	10.0	35.10

Figure 7.11E. Catch distribution by depth, temperature and salinity of Alligatorfish.

837

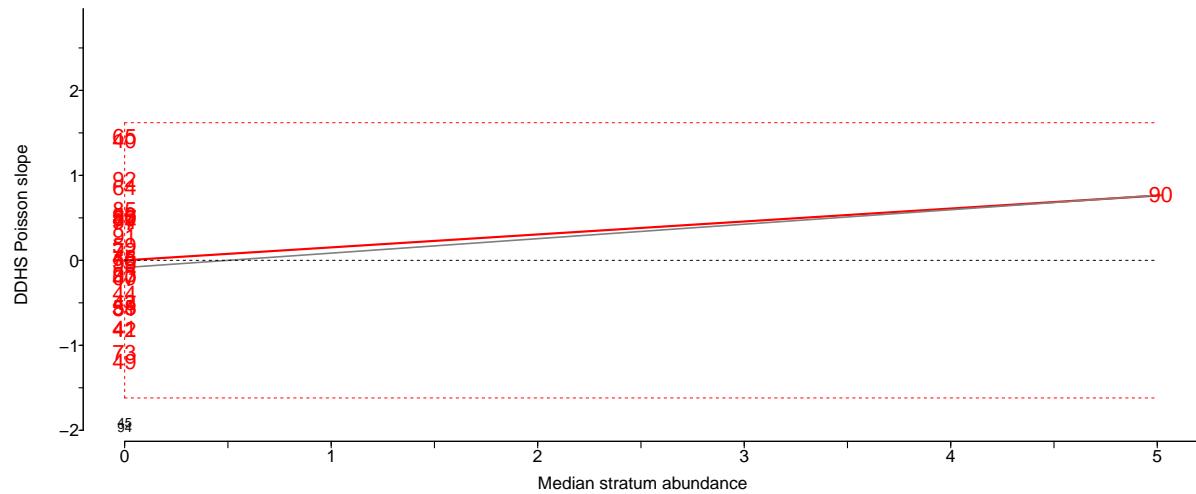


Figure 7.11F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Alligatorfish.

838

7.12 Atlantic halibut (Flétan de l'Atlantique) - species code 30 (category LF)

839

Scientific name: [Hippoglossus hippoglossus](#)

840

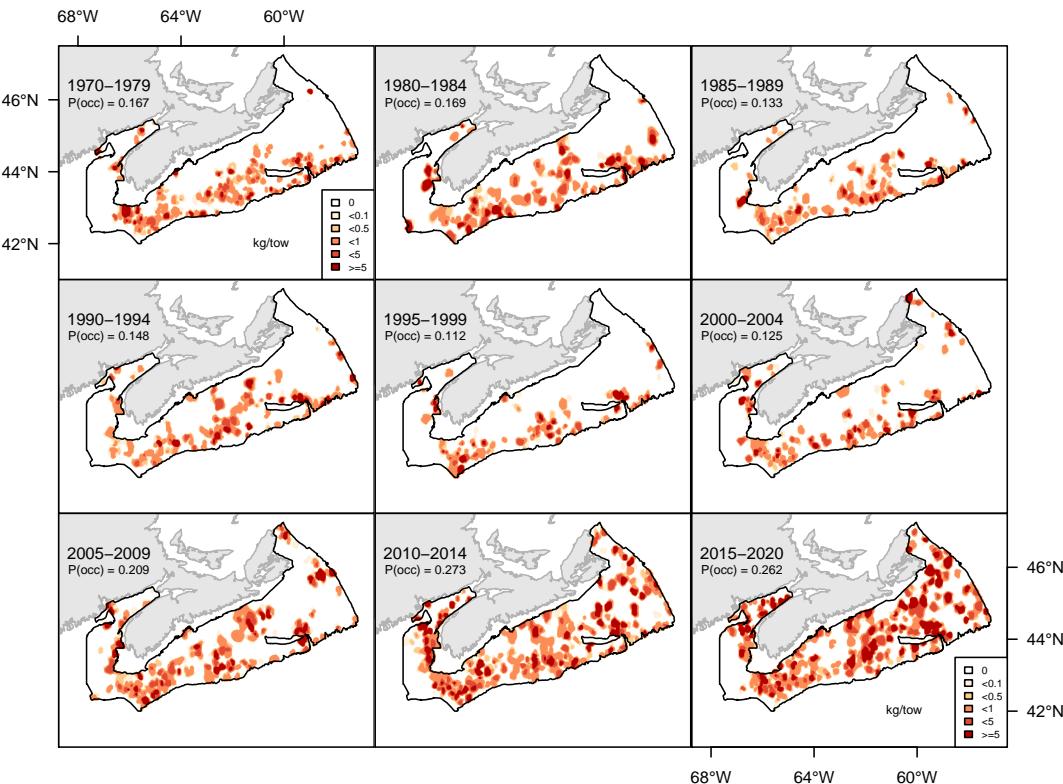


Figure 7.12A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic halibut.

841

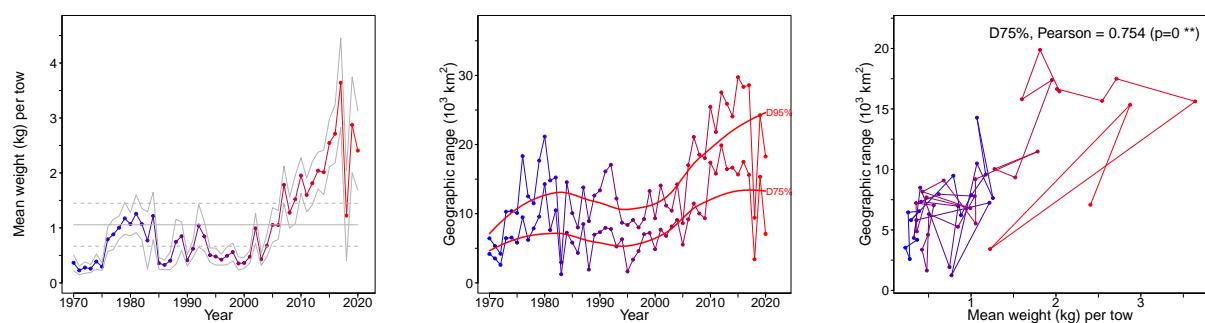


Figure 7.12B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic halibut.

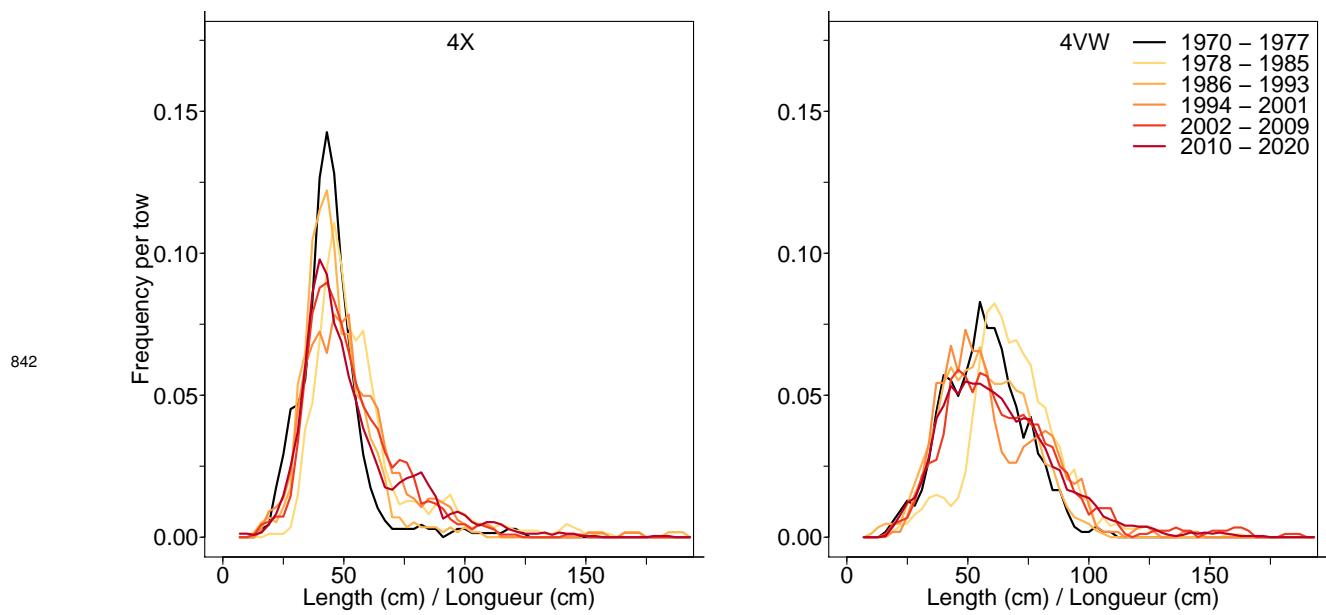


Figure 7.12C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic halibut.

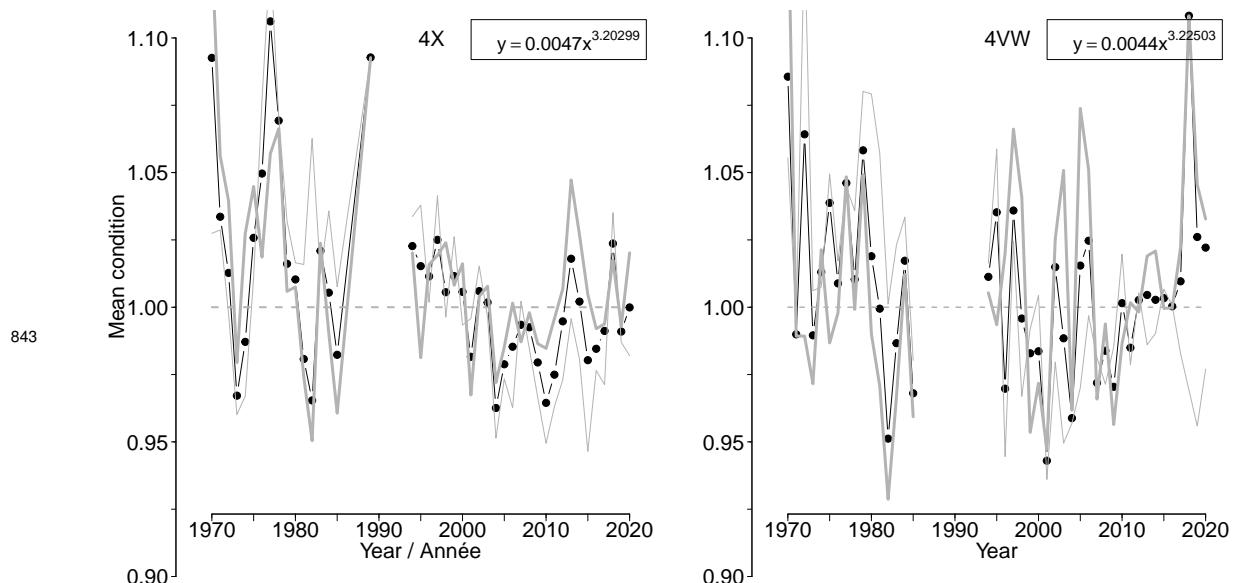
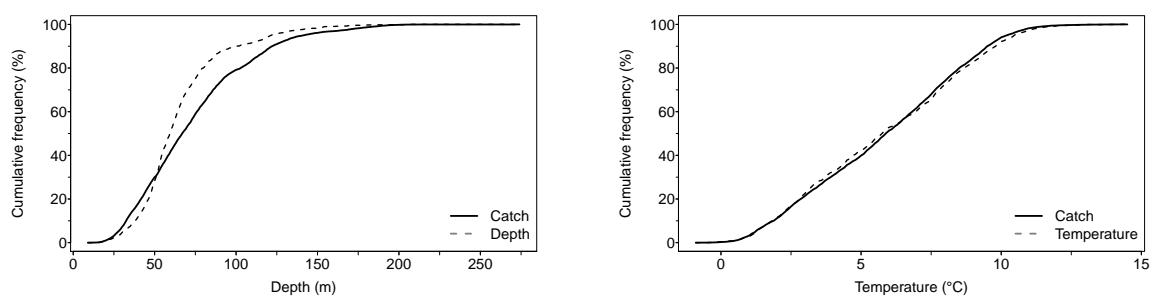
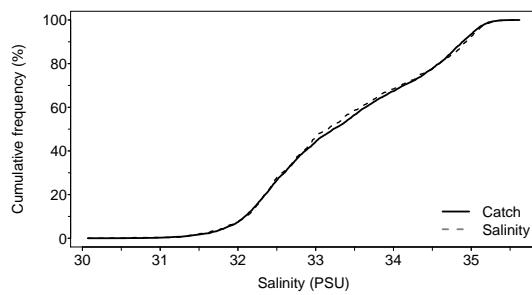


Figure 7.12D. Average fish condition in NAFO units 4X and 4VW for Atlantic halibut.



844



Freq	Depth	Temp	Sal
F5	31	1.3	31.00
F25	49	3.2	32.45
F50	60	5.8	33.16
F75	75	8.3	34.34
F95	122	10.0	35.08

Figure 7.12E. Catch distribution by depth, temperature and salinity of Atlantic halibut.

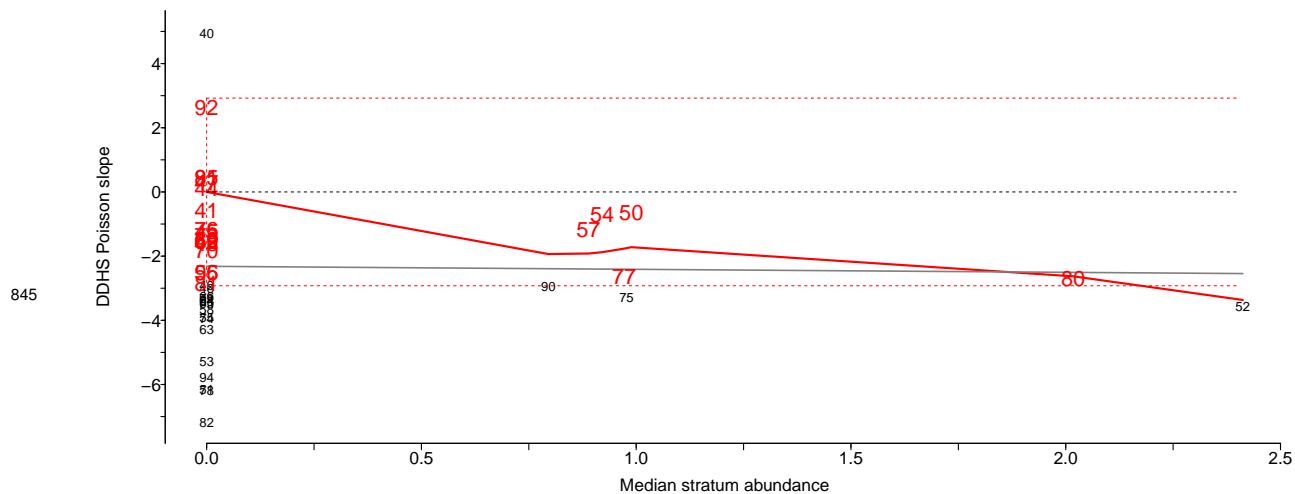


Figure 7.12F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic halibut.

846

7.13 American plaice (Plie canadienne) - species code 40 (category LF)

847

Scientific name: [Hippoglossoides platessoides](#)

848

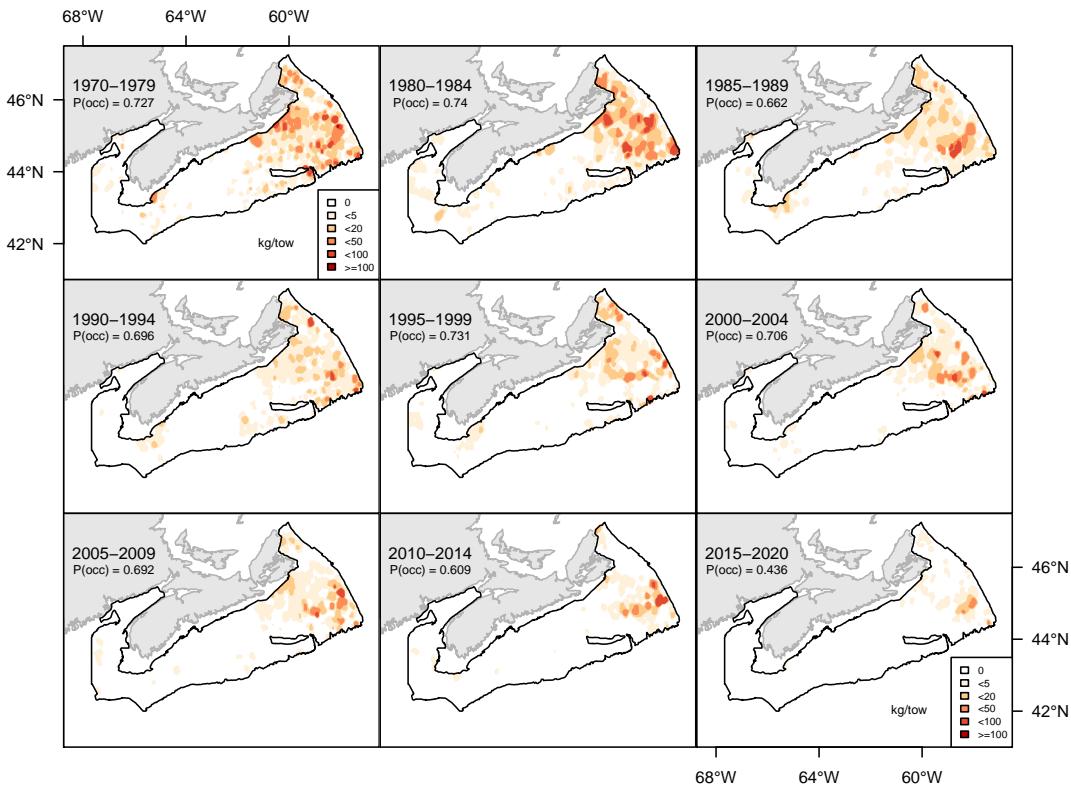


Figure 7.13A. Inverse distance weighted distribution of catch biomass (kg/tow) for American plaice.

849

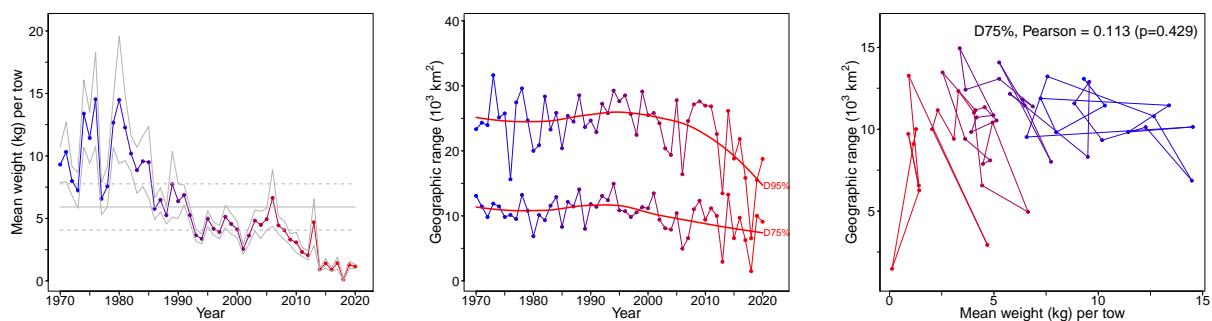


Figure 7.13B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American plaice.

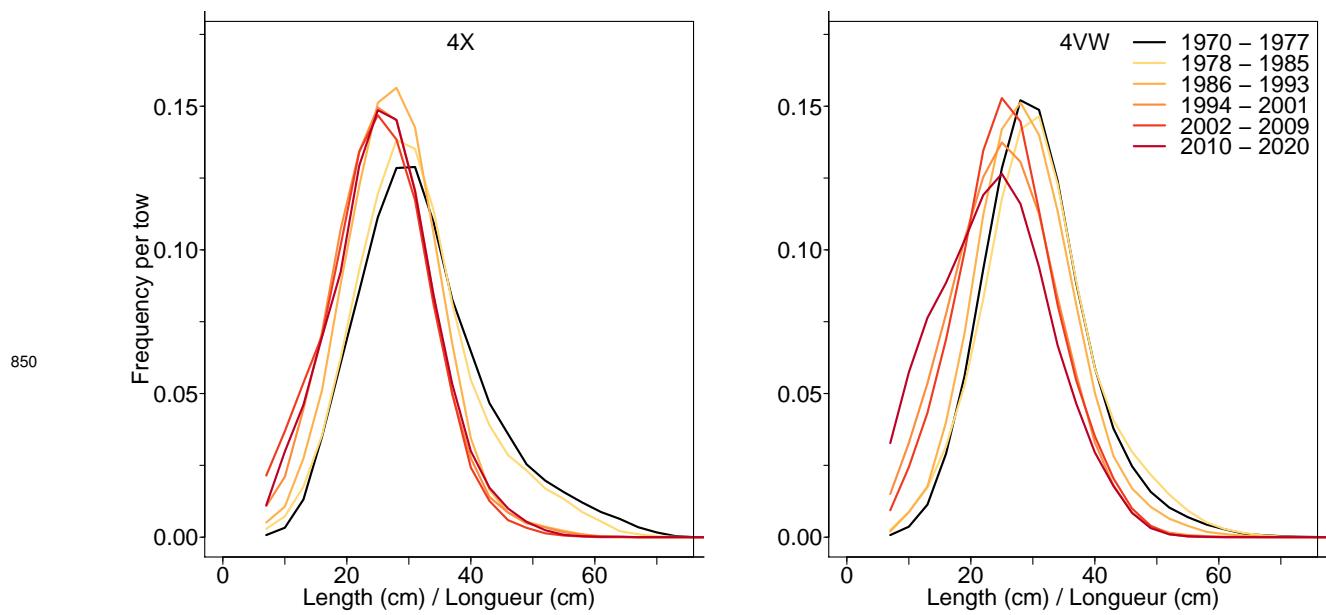


Figure 7.13C. Length frequency distribution in NAFO units 4X and 4VW for American plaice.

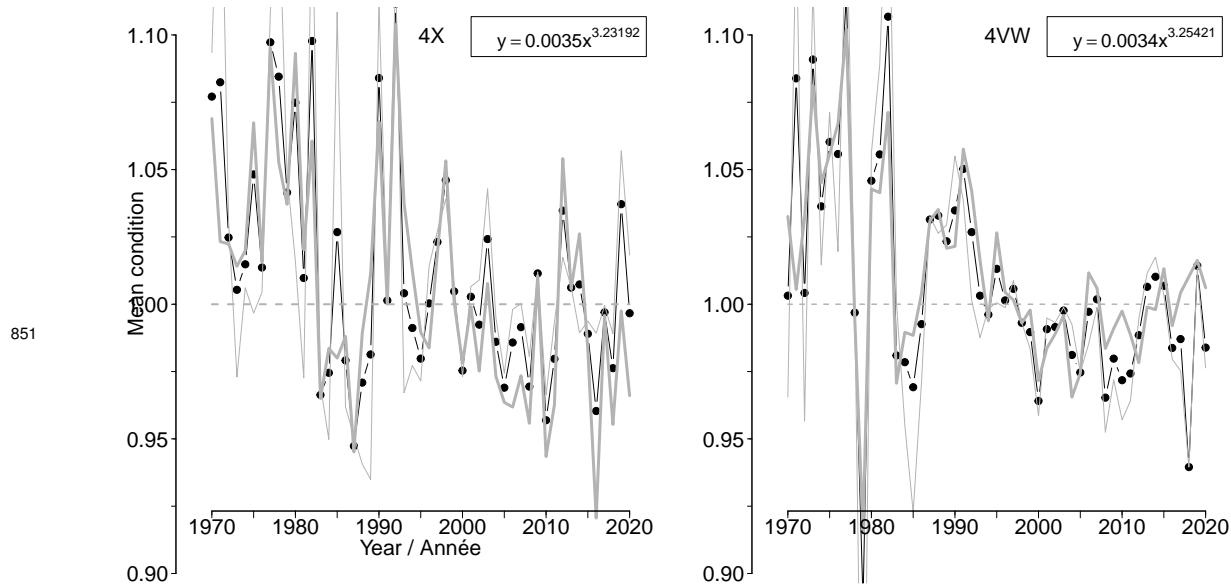
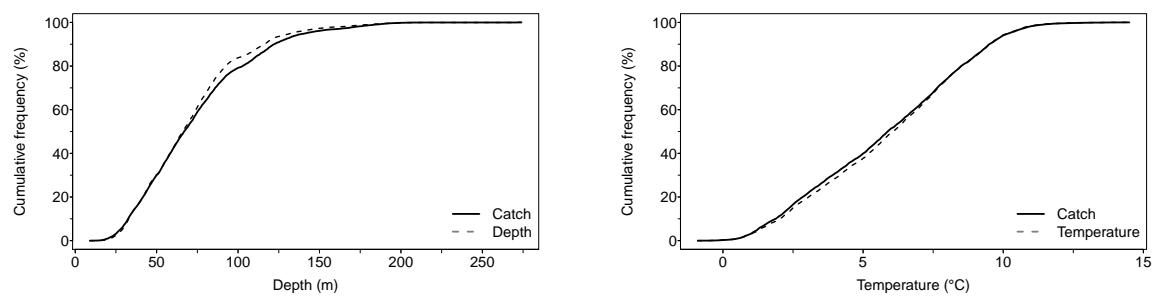
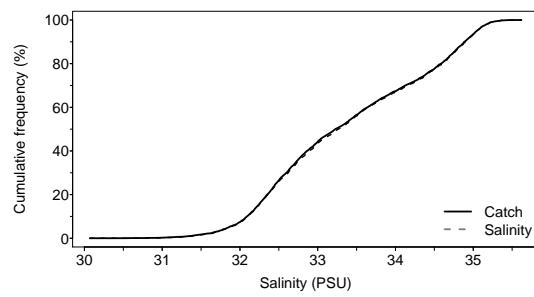


Figure 7.13D. Average fish condition in NAFO units 4X and 4VW for American plaice.



852



Freq	Depth	Temp	Sal
F5	29	1.3	31.00
F25	46	3.7	32.48
F50	67	6.1	33.27
F75	87	8.1	34.41
F95	133	10.0	35.05

Figure 7.13E. Catch distribution by depth, temperature and salinity of American plaice.

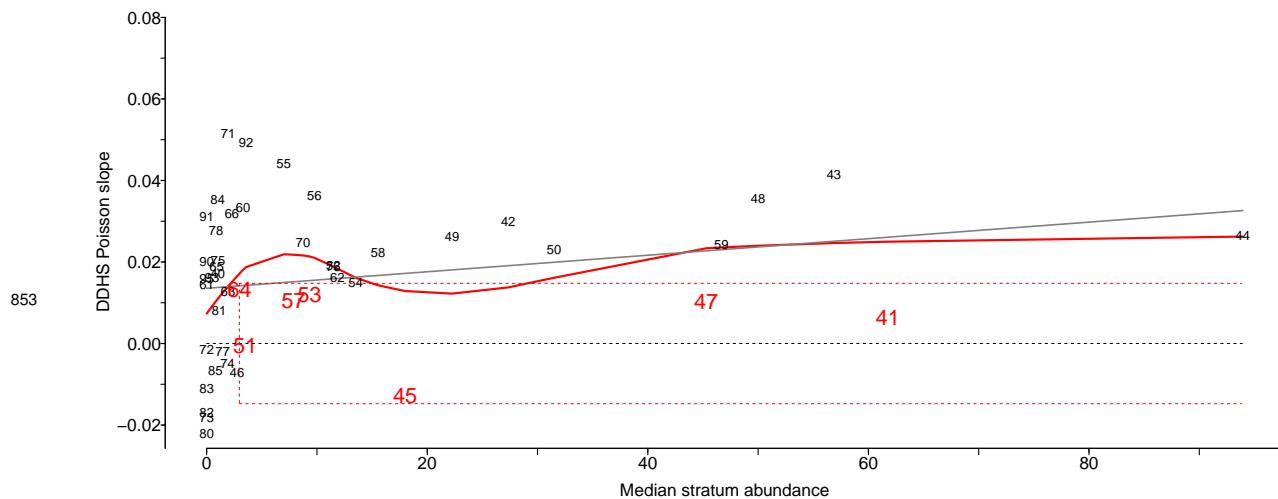


Figure 7.13F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for American plaice.

854

7.14 Witch flounder (*Ple grise*) - species code 41 (category LF)

855

Scientific name: [Glyptocephalus cynoglossus](#)

856

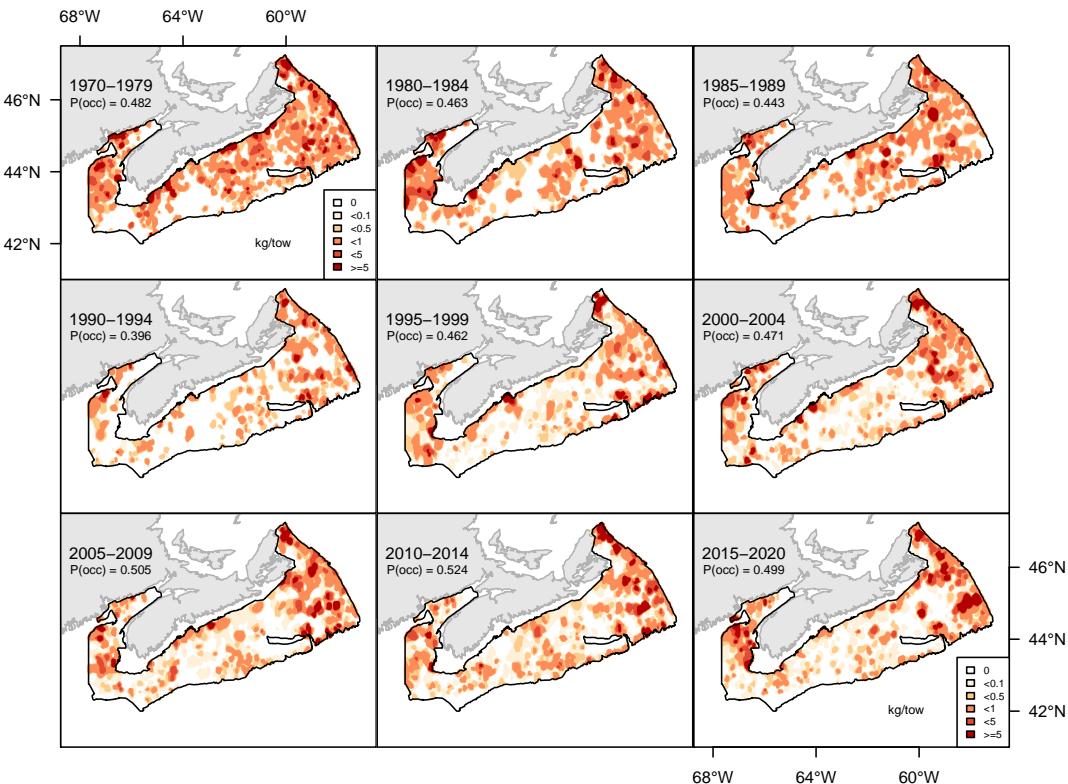


Figure 7.14A. Inverse distance weighted distribution of catch biomass (kg/tow) for Witch flounder.

857

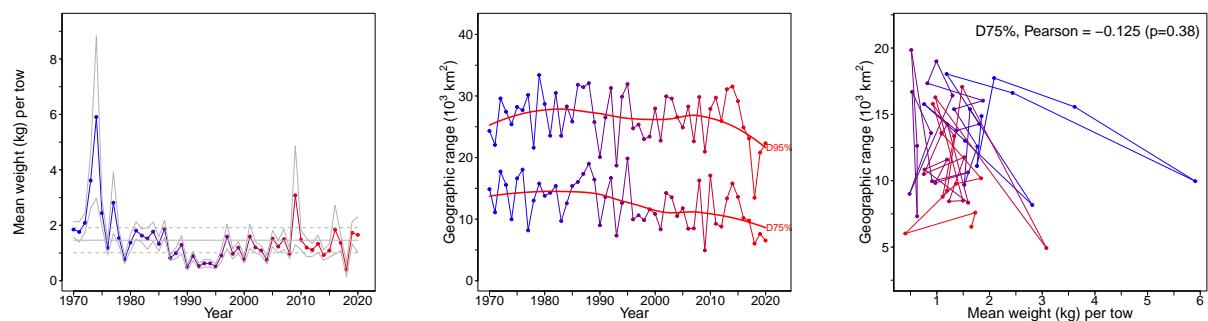


Figure 7.14B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Witch flounder.

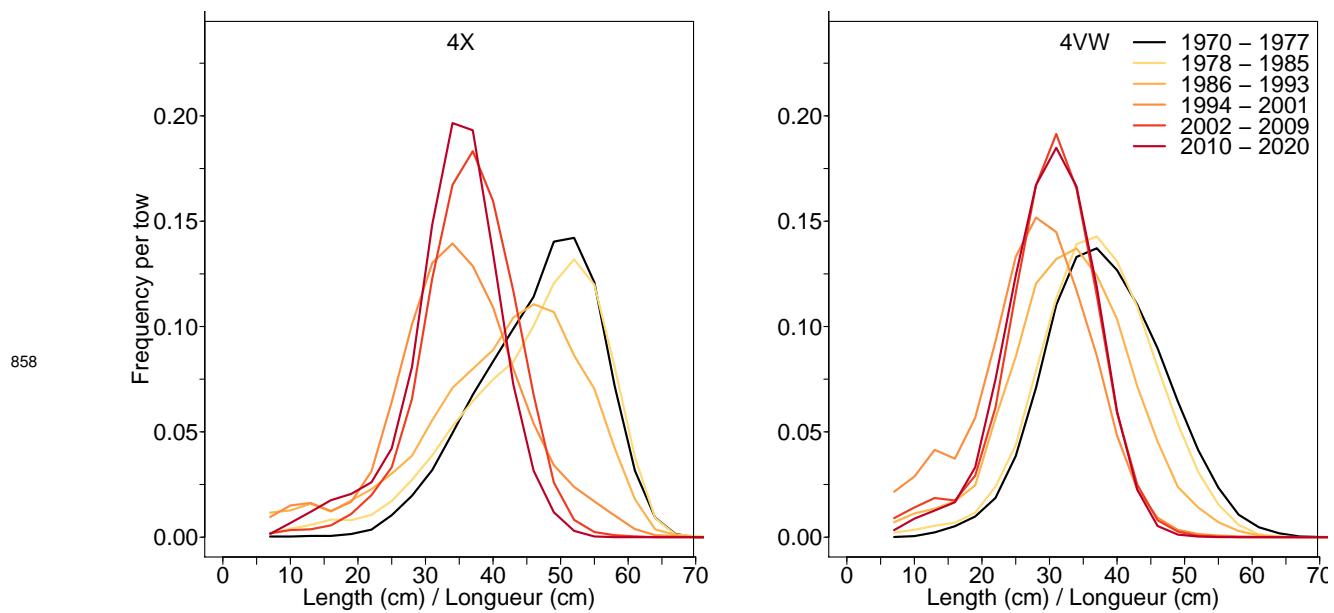


Figure 7.14C. Length frequency distribution in NAFO units 4X and 4VW for Witch flounder.

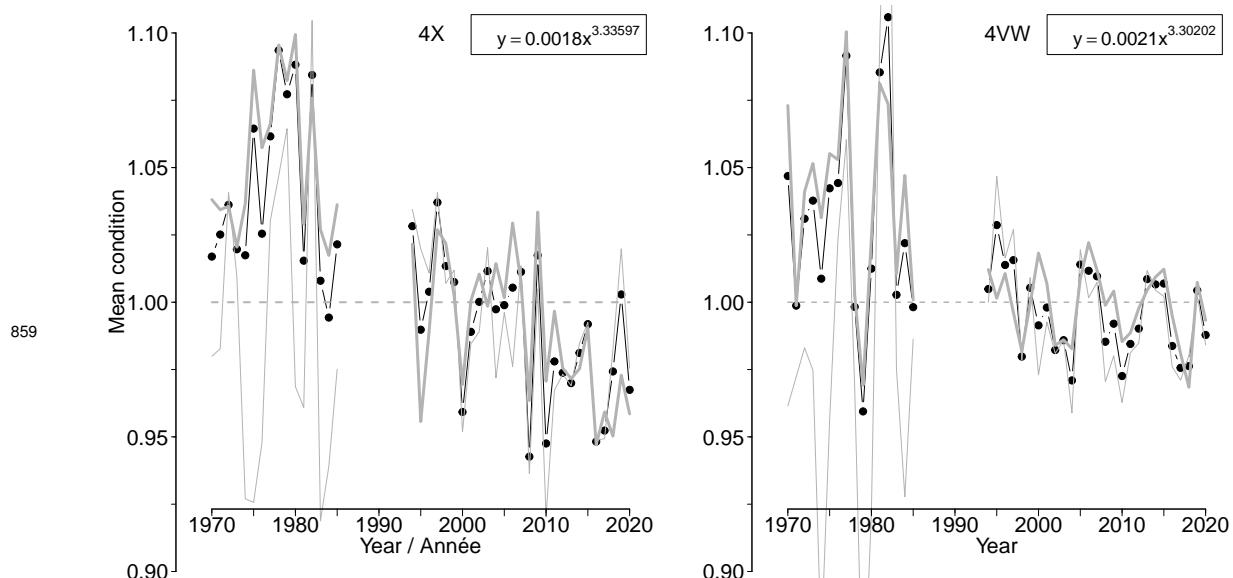


Figure 7.14D. Average fish condition in NAFO units 4X and 4VW for Witch flounder.

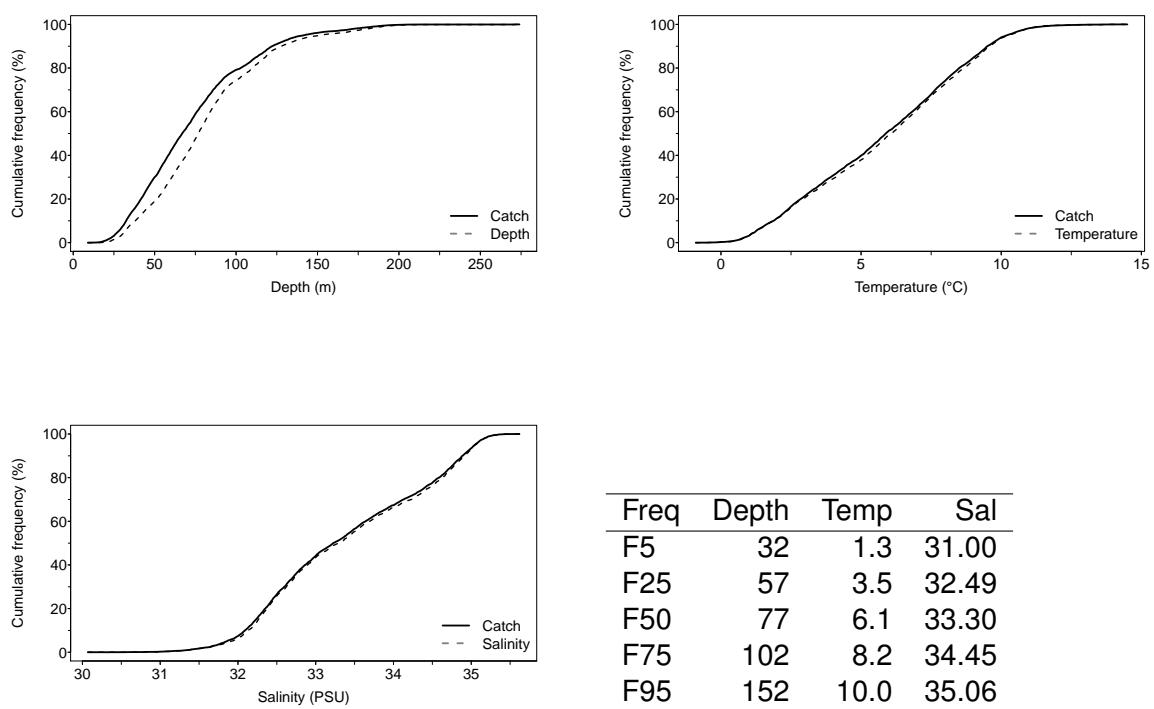


Figure 7.14E. Catch distribution by depth, temperature and salinity of Witch flounder.

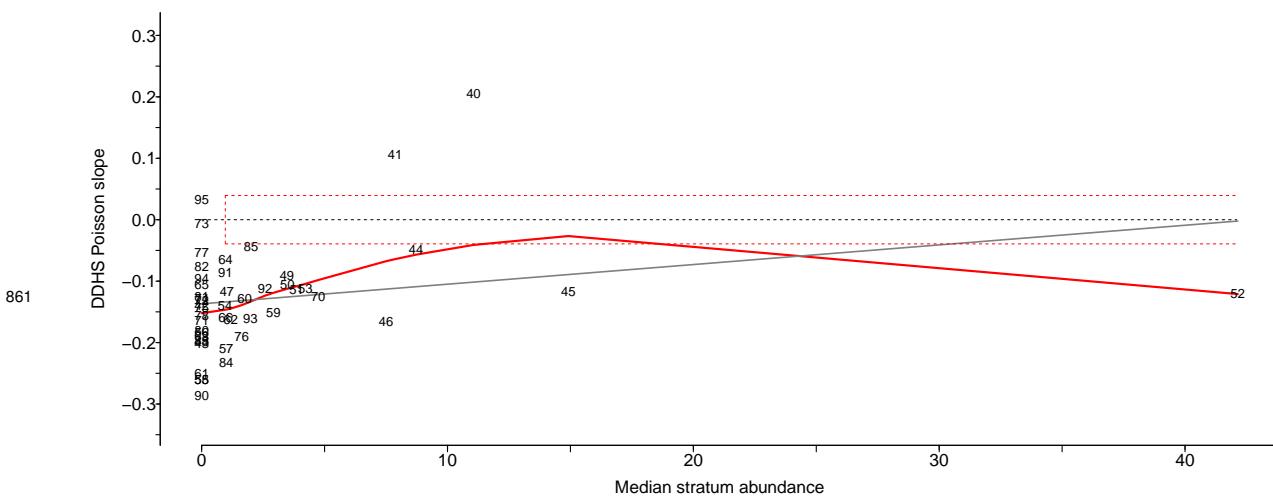


Figure 7.14F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Witch flounder.

862 **7.15 Yellowtail flounder (Limande à queue jaune) - species code 42 (category LF)**

863 Scientific name: [Limanda ferruginea](#)

864

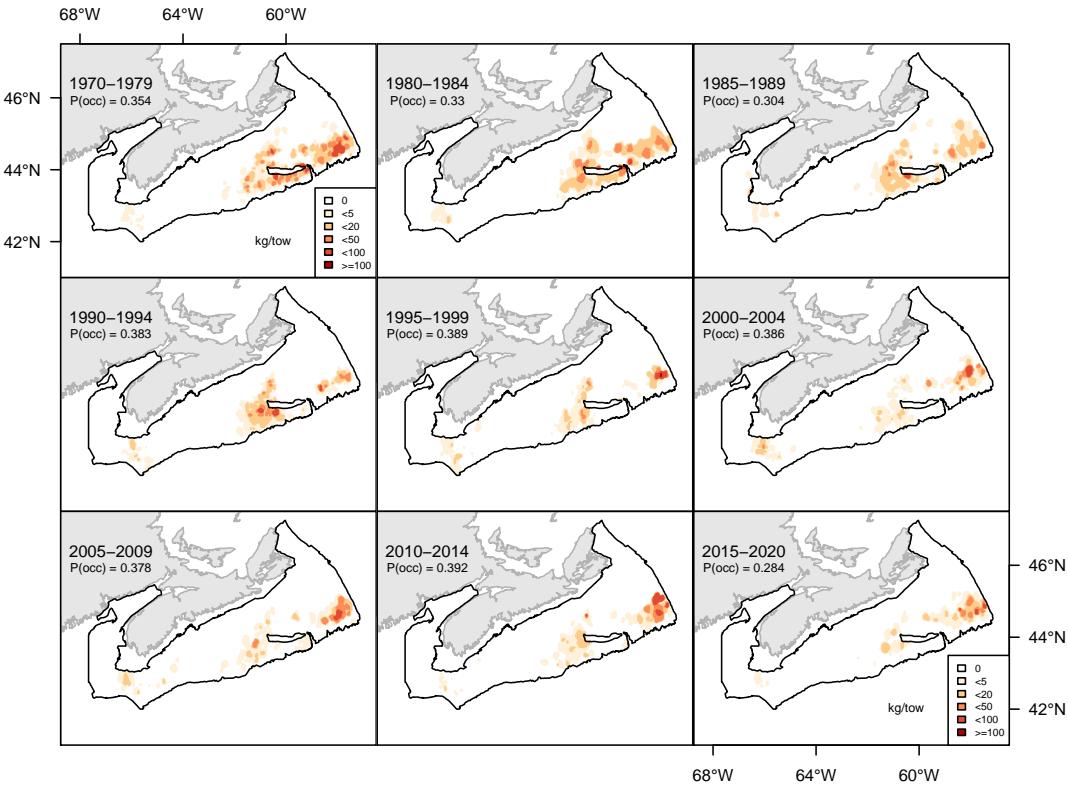


Figure 7.15A. Inverse distance weighted distribution of catch biomass (kg/tow) for Yellowtail flounder.

865

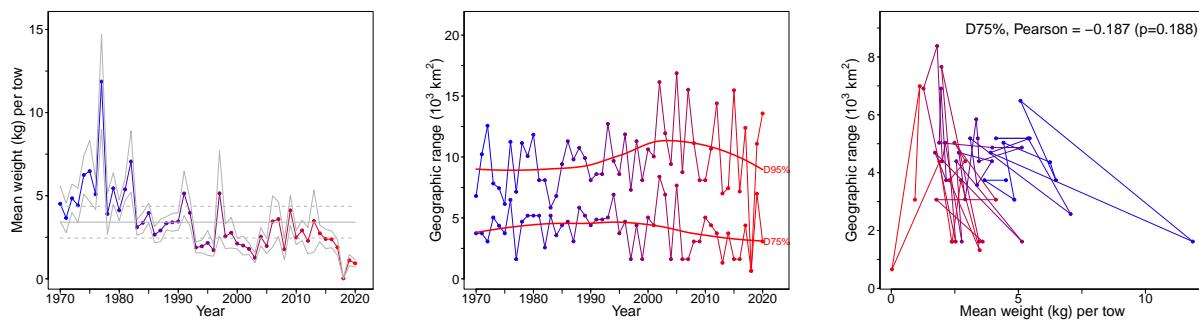


Figure 7.15B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Yellowtail flounder.

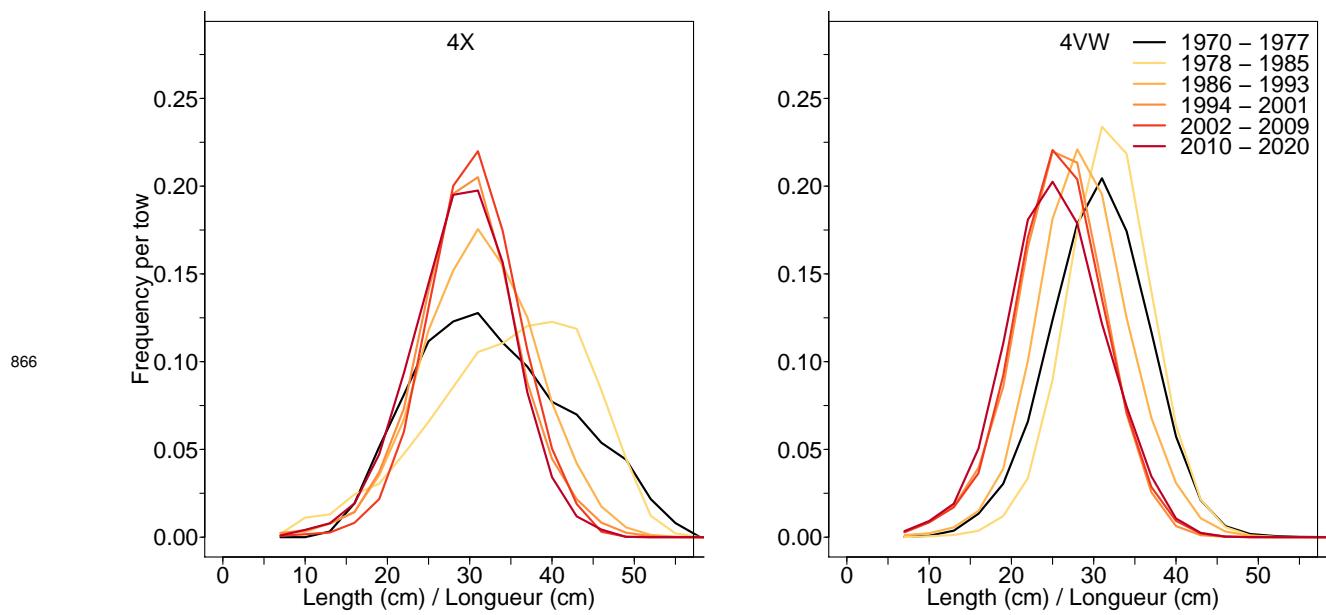


Figure 7.15C. Length frequency distribution in NAFO units 4X and 4VW for Yellowtail flounder.

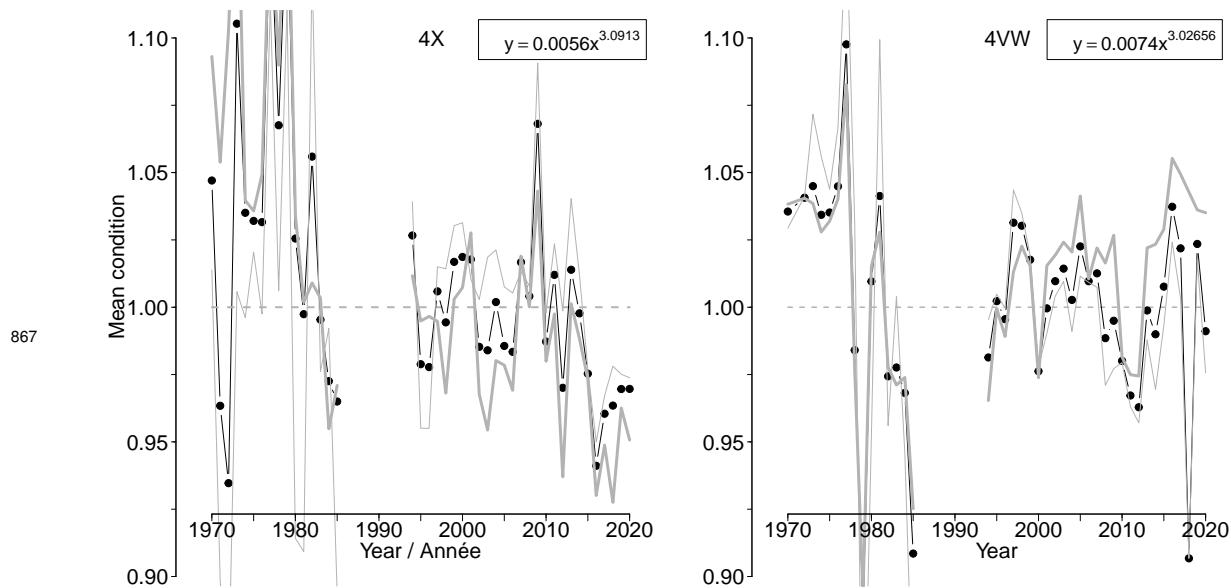
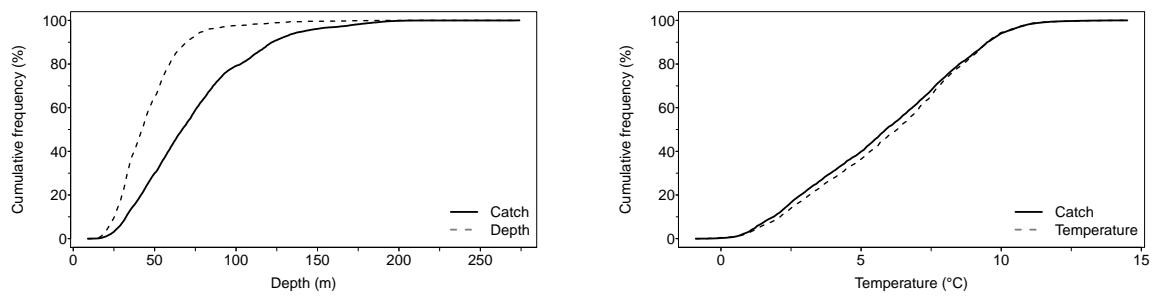
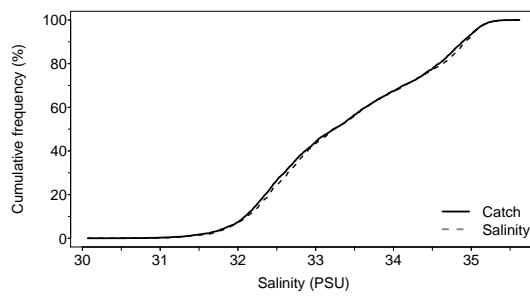


Figure 7.15D. Average fish condition in NAFO units 4X and 4VW for Yellowtail flounder.



868



Freq	Depth	Temp	Sal
F5	22	1.4	31.00
F25	32	3.7	32.52
F50	43	6.3	33.25
F75	56	8.2	34.41
F95	81	10.0	35.06

Figure 7.15E. Catch distribution by depth, temperature and salinity of Yellowtail flounder.

869

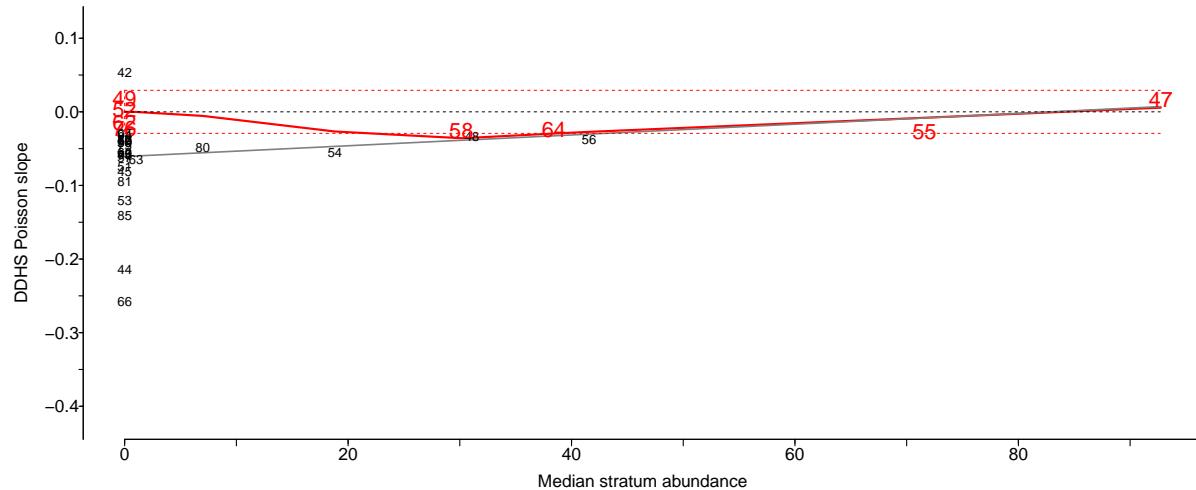


Figure 7.15F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Yellowtail flounder.

870

7.16 Winter flounder (Limande-plie rouge) - species code 43 (category LF)

871

Scientific name: *Pseudopleuronectes americanus*

872

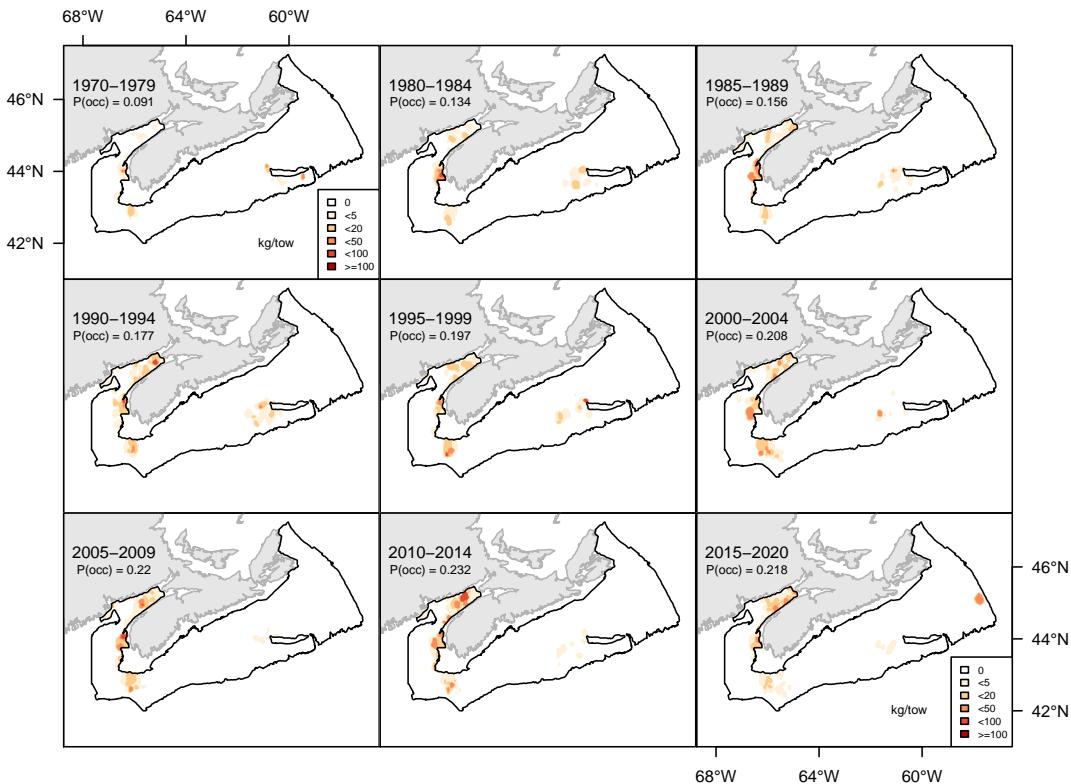


Figure 7.16A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter flounder.

873

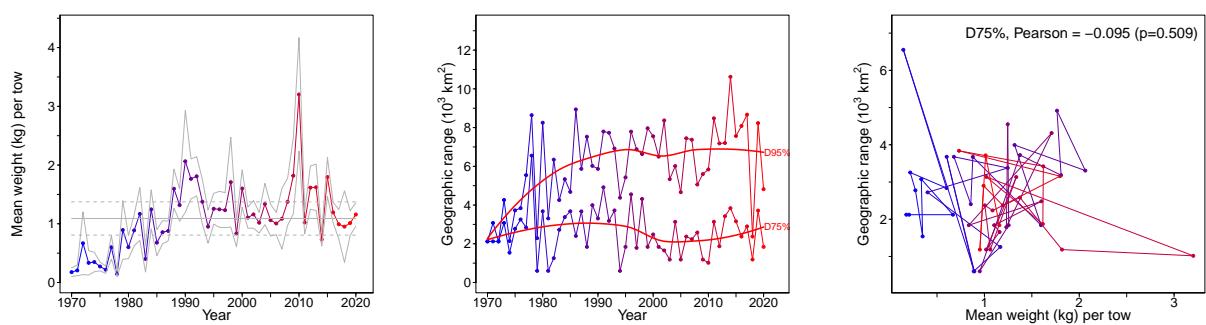


Figure 7.16B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter flounder.

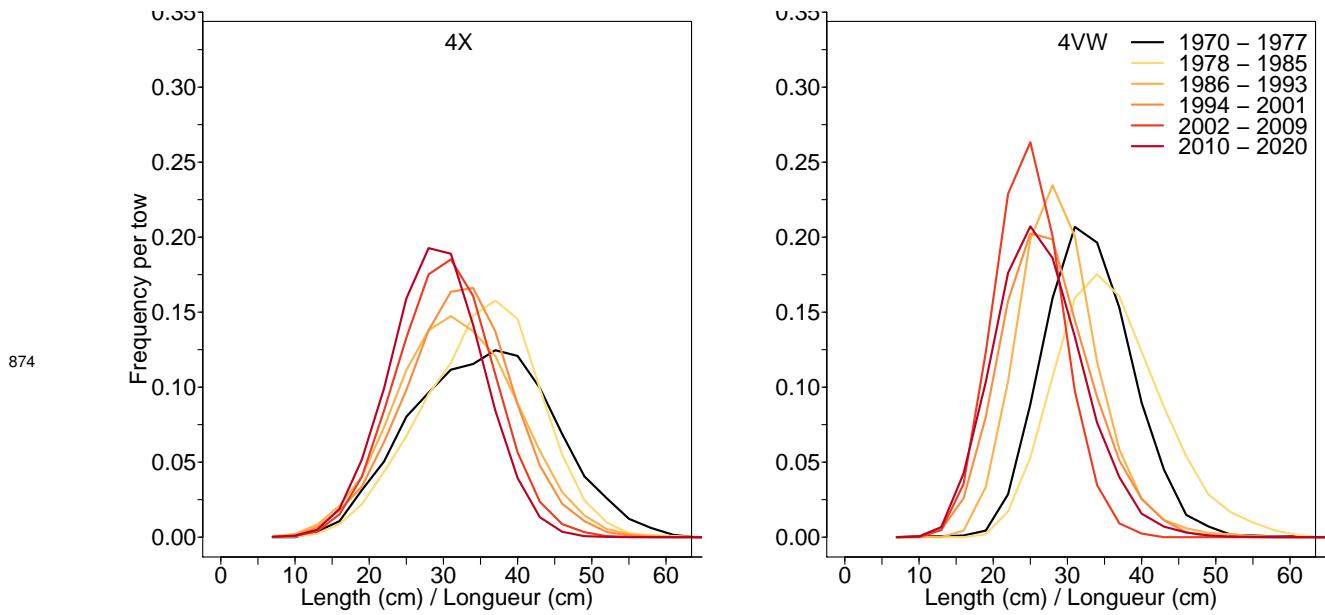


Figure 7.16C. Length frequency distribution in NAFO units 4X and 4VW for Winter flounder.

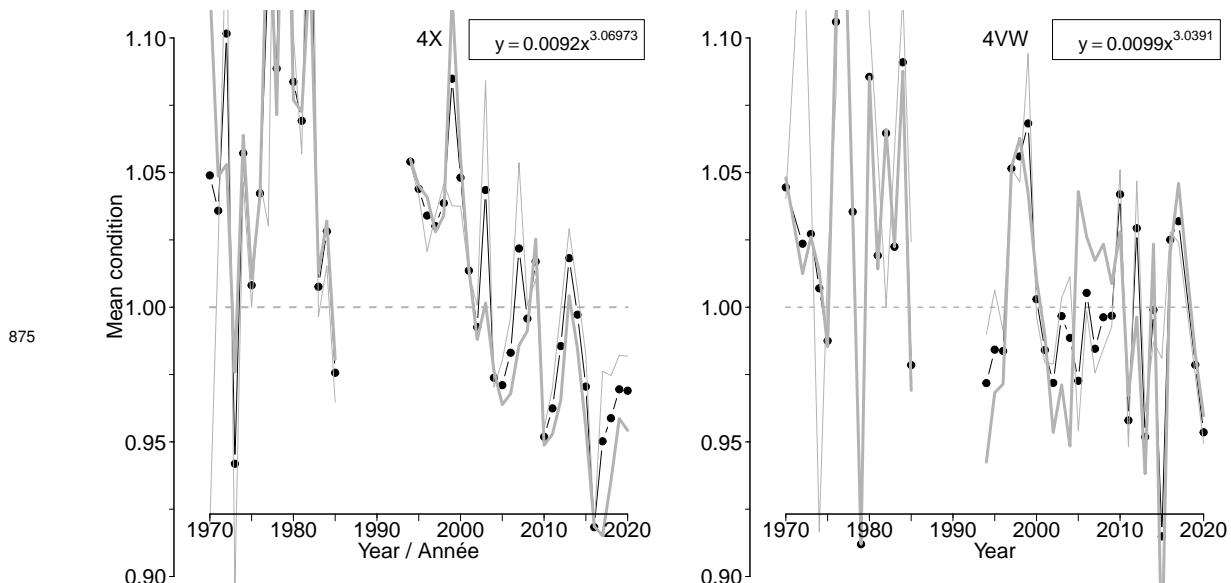
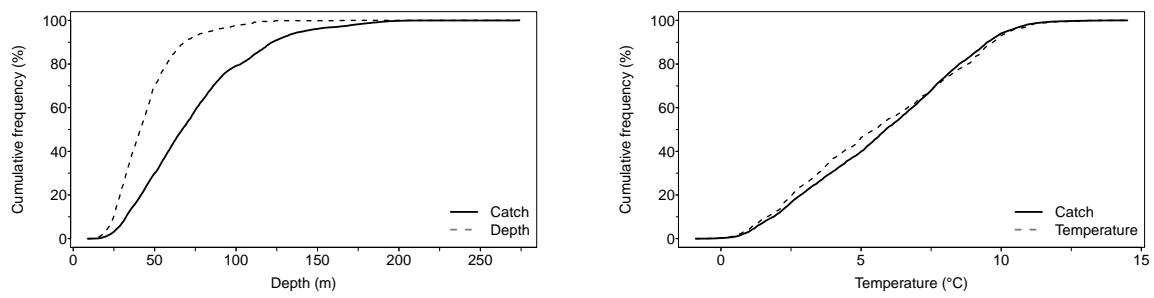
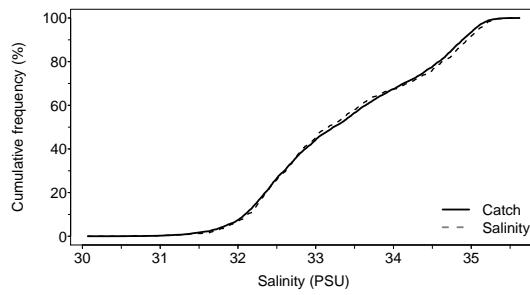


Figure 7.16D. Average fish condition in NAFO units 4X and 4VW for Winter flounder.



876



Freq	Depth	Temp	Sal
F5	22	1.1	31.00
F25	31	3.0	32.48
F50	42	5.5	33.17
F75	54	8.3	34.47
F95	84	10.0	35.10

Figure 7.16E. Catch distribution by depth, temperature and salinity of Winter flounder.

877

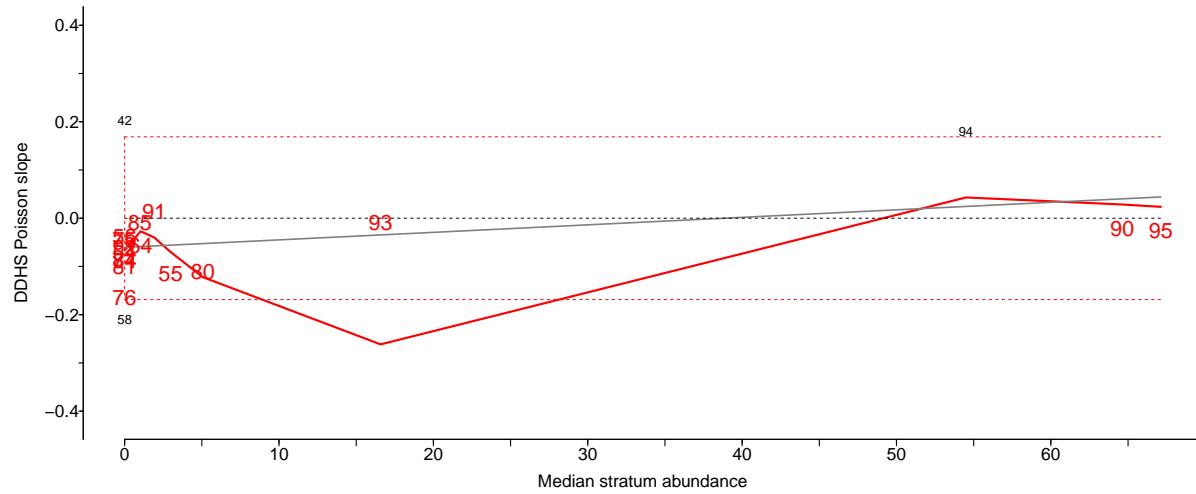


Figure 7.16F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter flounder.

878

7.17 Atlantic wolffish (*Loup atlantique*) - species code 50 (category LF)

879

Scientific name: [Anarhichas lupus](#)

880

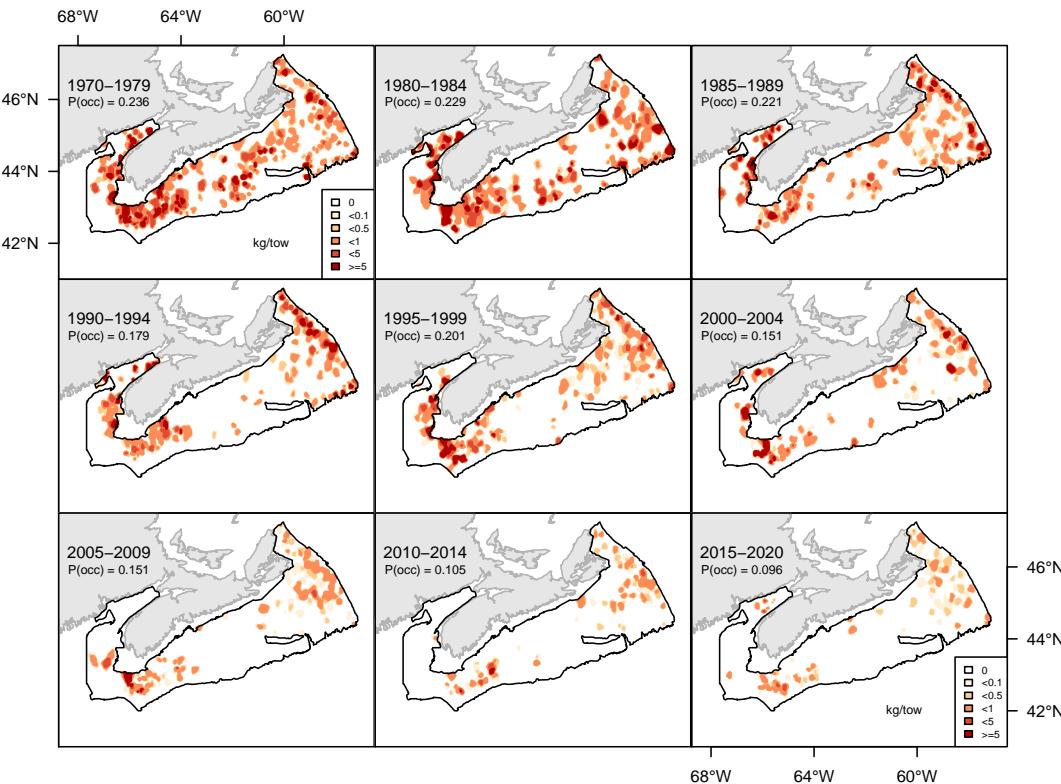


Figure 7.17A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic wolffish.

881

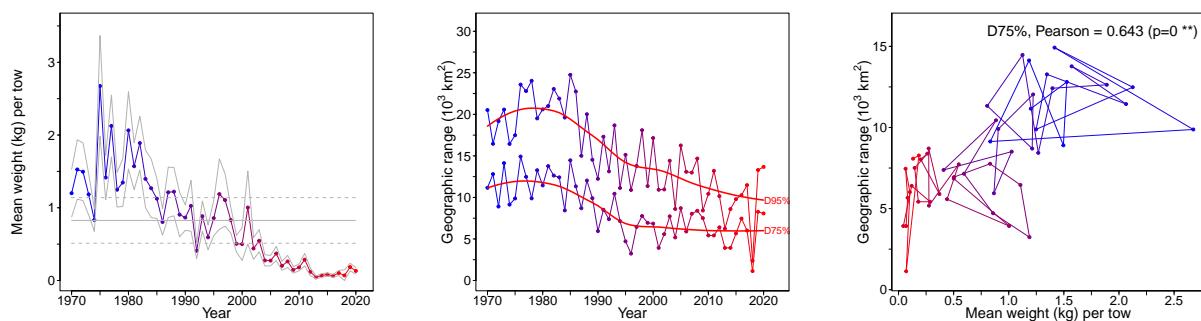


Figure 7.17B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic wolffish.

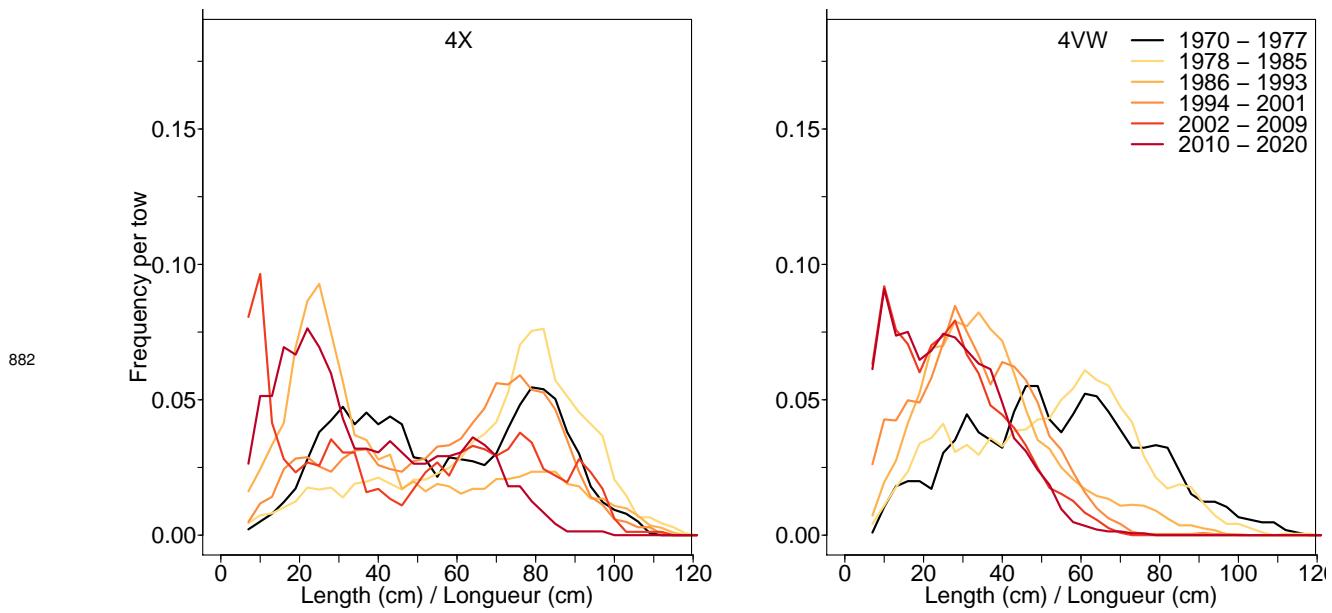


Figure 7.17C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic wolffish.

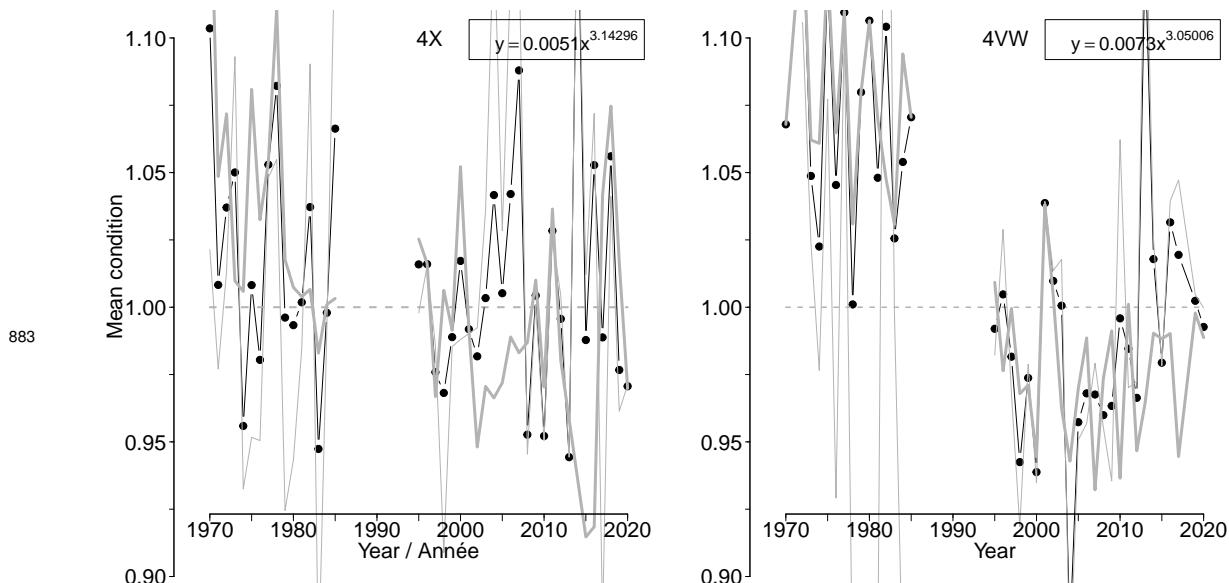
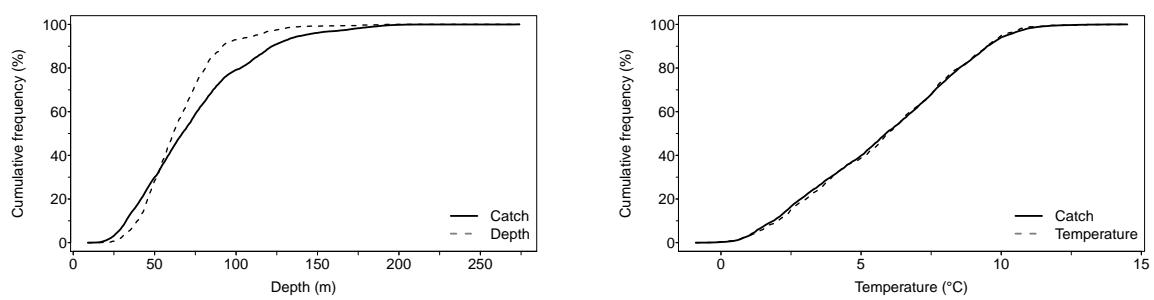
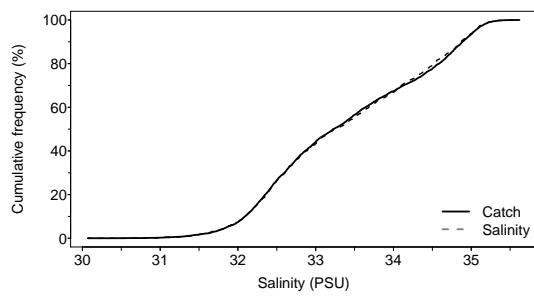


Figure 7.17D. Average fish condition in NAFO units 4X and 4VW for Atlantic wolffish.



884



Freq	Depth	Temp	Sal
F5	34	1.4	31.00
F25	49	3.6	32.48
F50	62	6.0	33.25
F75	77	8.1	34.33
F95	112	10.0	35.05

Figure 7.17E. Catch distribution by depth, temperature and salinity of Atlantic wolffish.

885

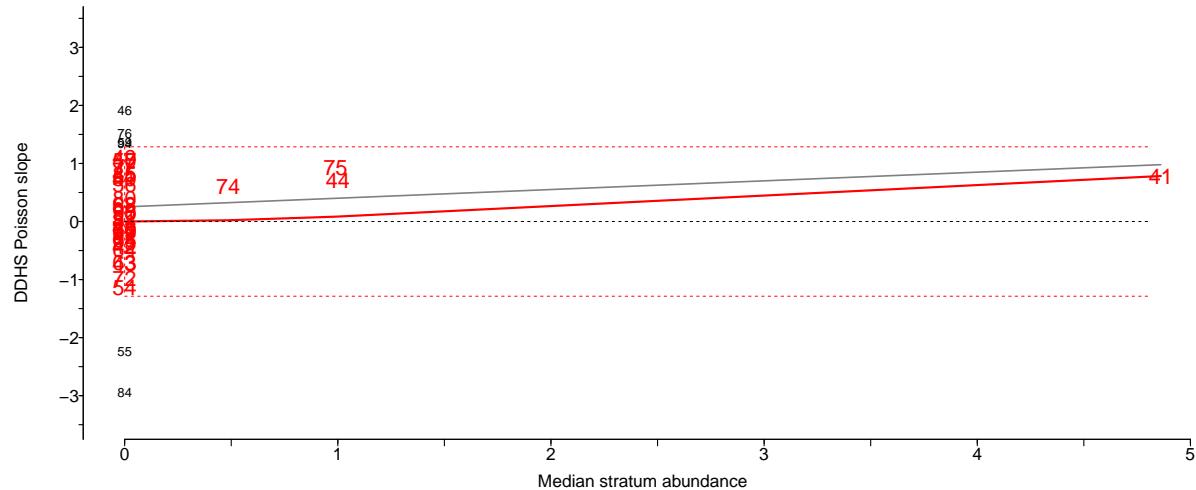


Figure 7.17F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic wolffish.

886 **7.18 Ocean pout (Loquette d'Amérique) - species code 640 (category LF)**

887 Scientific name: [Zoarces americanus](#)

888

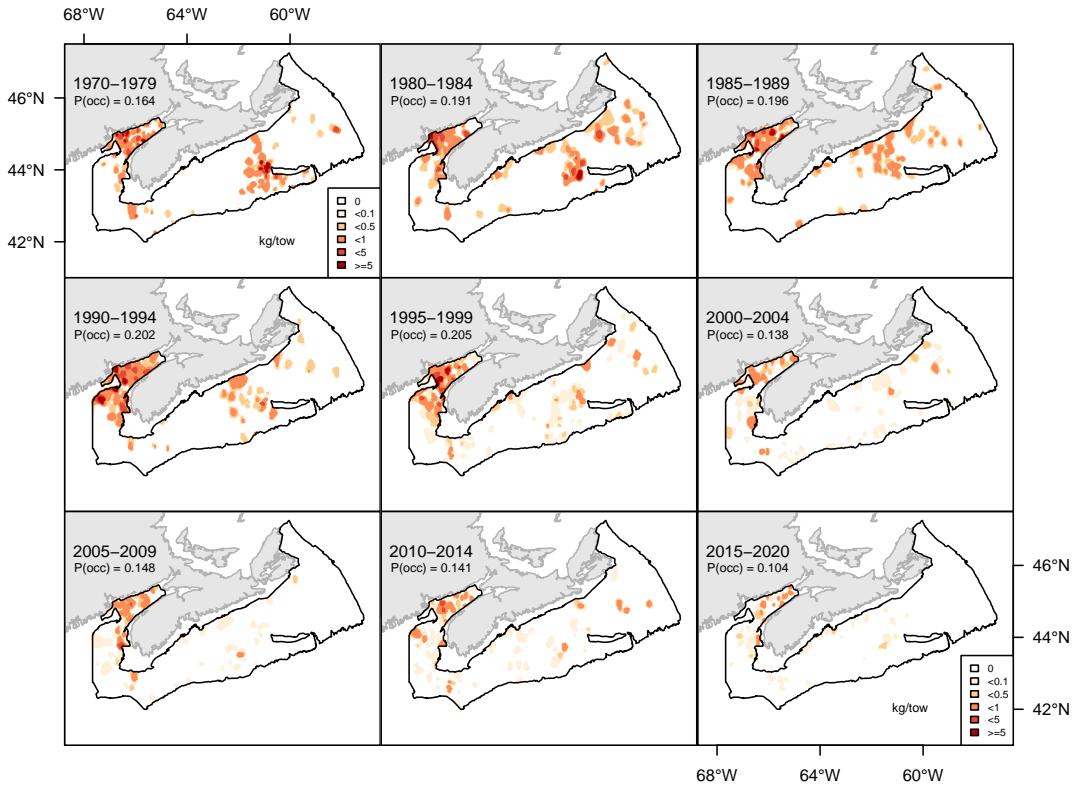


Figure 7.18A. Inverse distance weighted distribution of catch biomass (kg/tow) for Ocean pout.

889

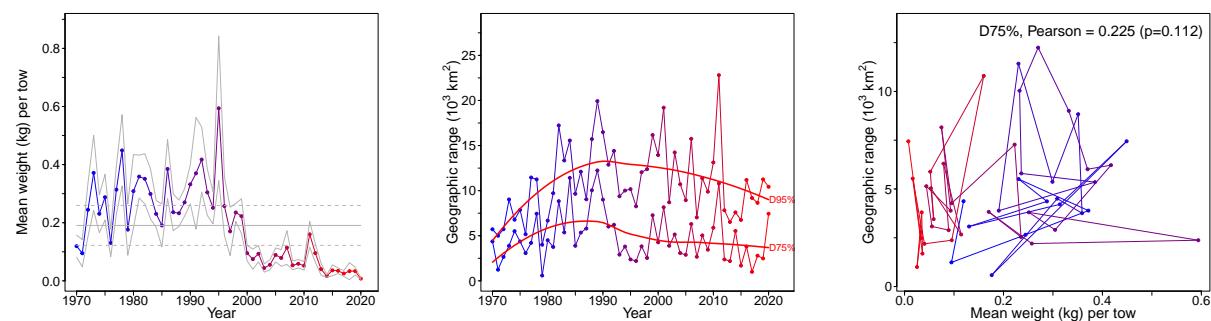


Figure 7.18B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Ocean pout.

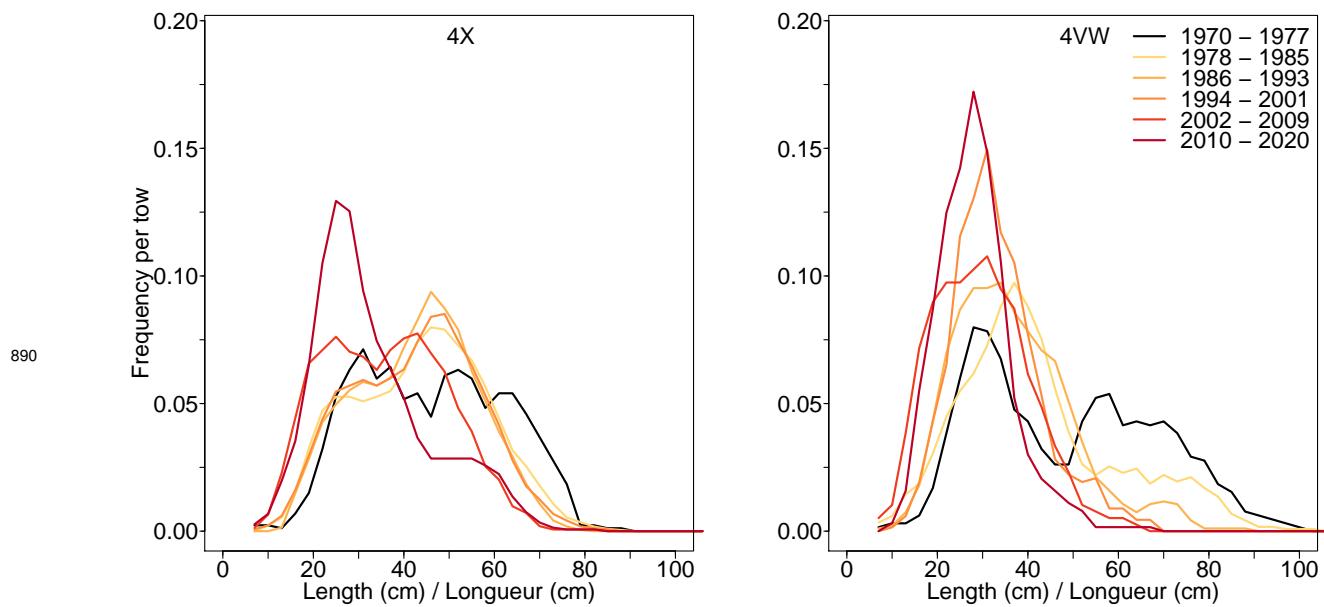


Figure 7.18C. Length frequency distribution in NAFO units 4X and 4VW for Ocean pout.

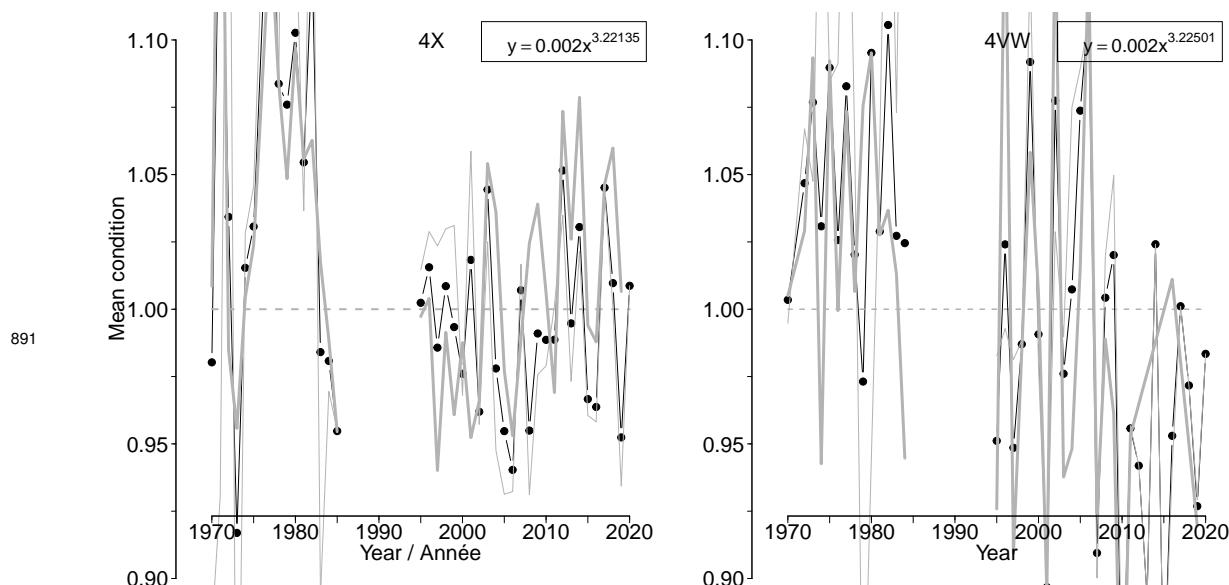
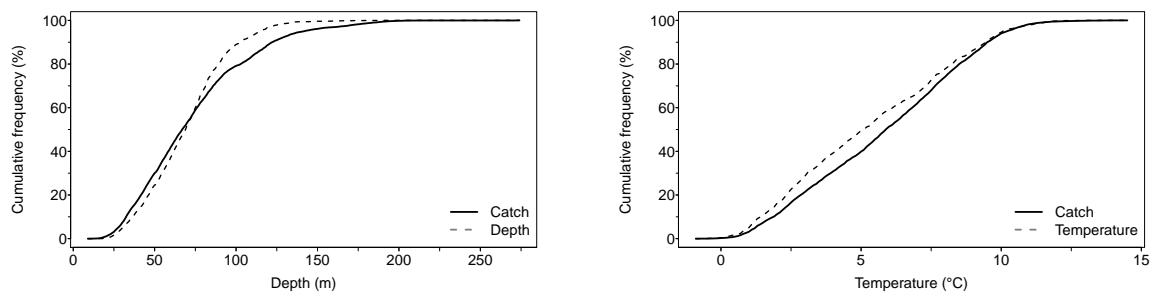
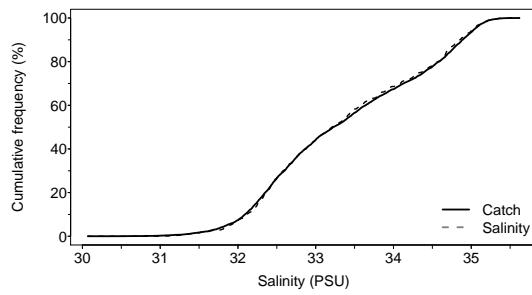


Figure 7.18D. Average fish condition in NAFO units 4X and 4VW for Ocean pout.



892



Freq	Depth	Temp	Sal
F5	31	1.0	31.00
F25	52	2.8	32.46
F50	69	5.1	33.22
F75	85	7.7	34.34
F95	116	10.0	35.03

Figure 7.18E. Catch distribution by depth, temperature and salinity of Ocean pout.

893

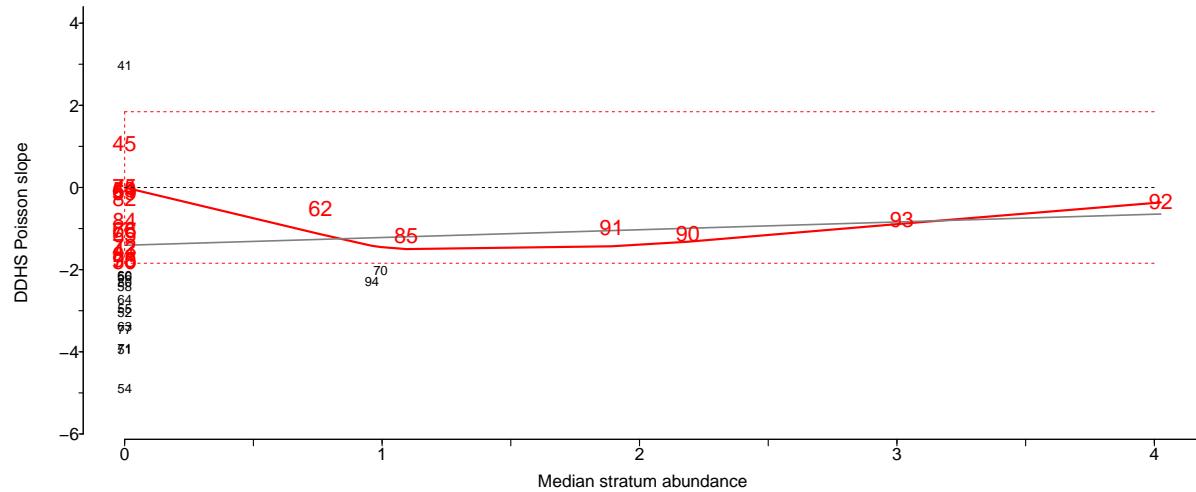


Figure 7.18F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Ocean pout.

894 **7.19 Atlantic herring (Hareng de l'Atlantique) - species code 60 (category LF)**

895 Scientific name: [Clupea harengus](#)

896

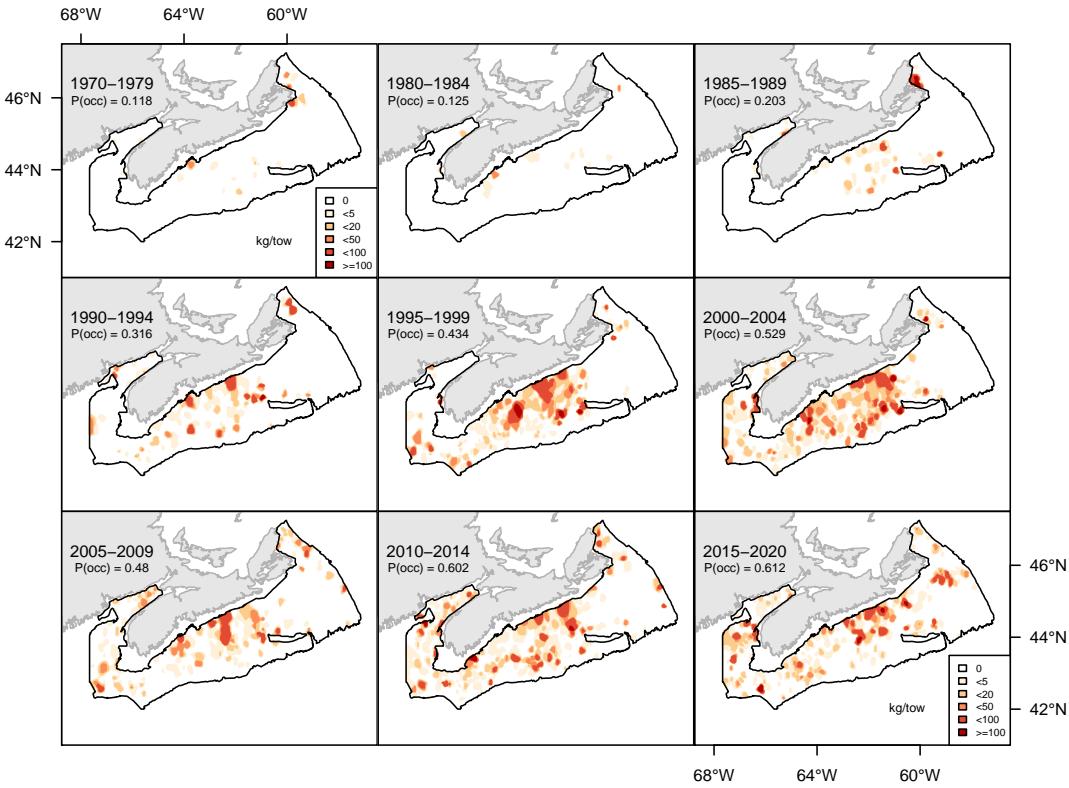


Figure 7.19A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic herring.

897

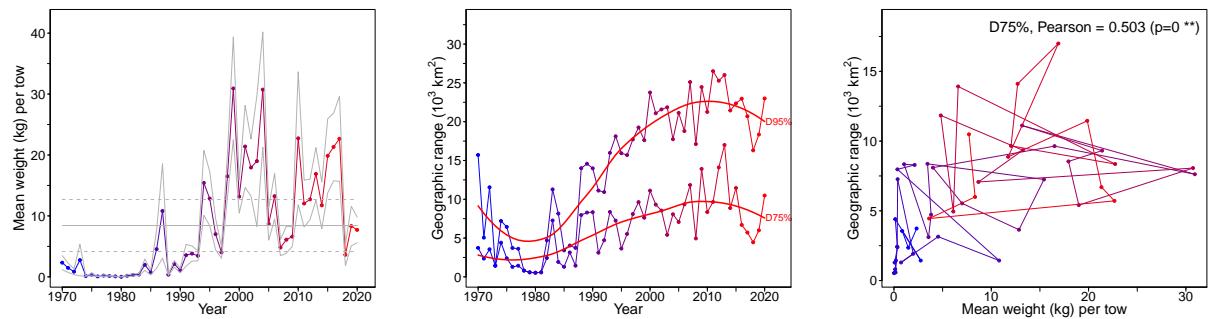


Figure 7.19B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic herring.

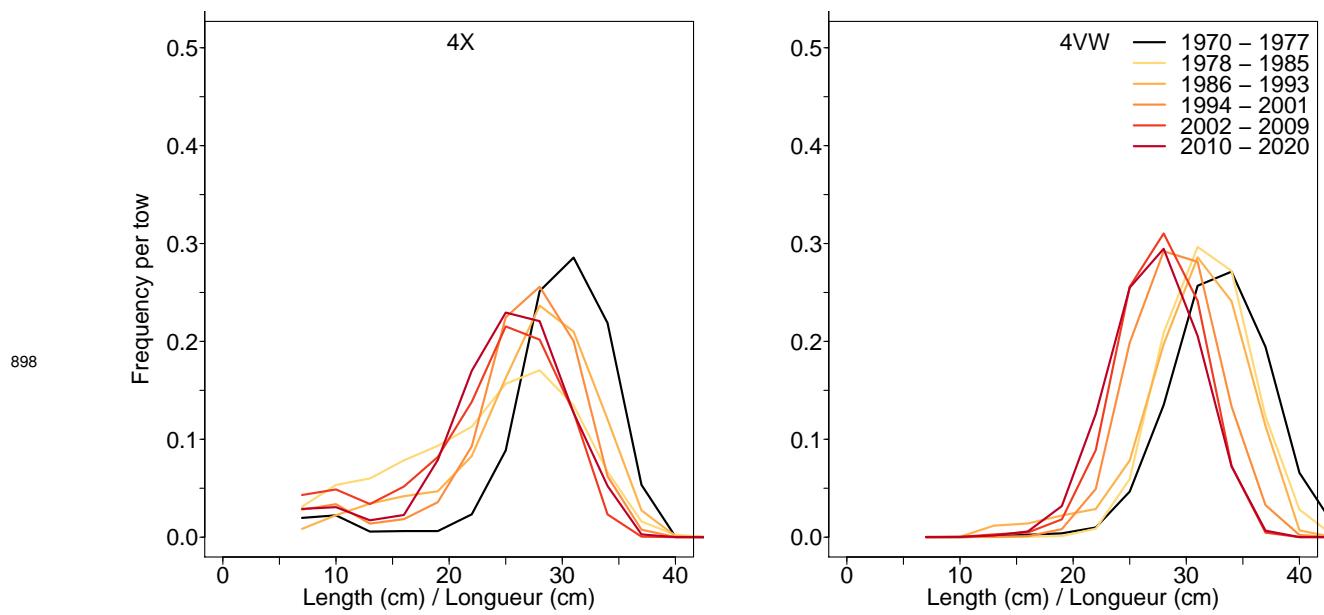


Figure 7.19C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic herring.

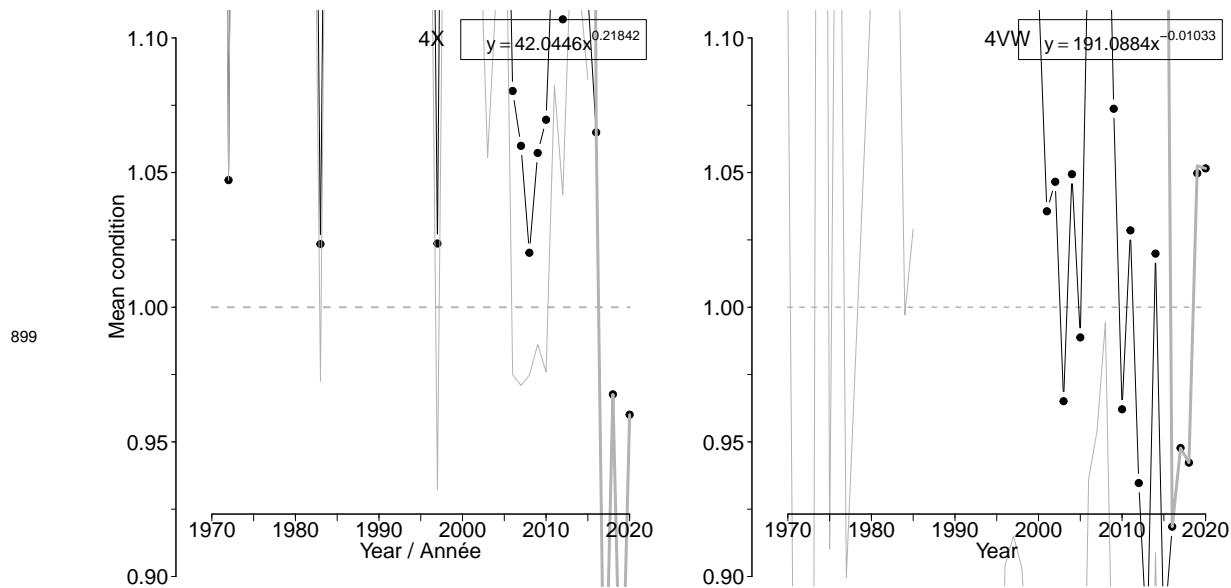


Figure 7.19D. Average fish condition in NAFO units 4X and 4VW for Atlantic herring.

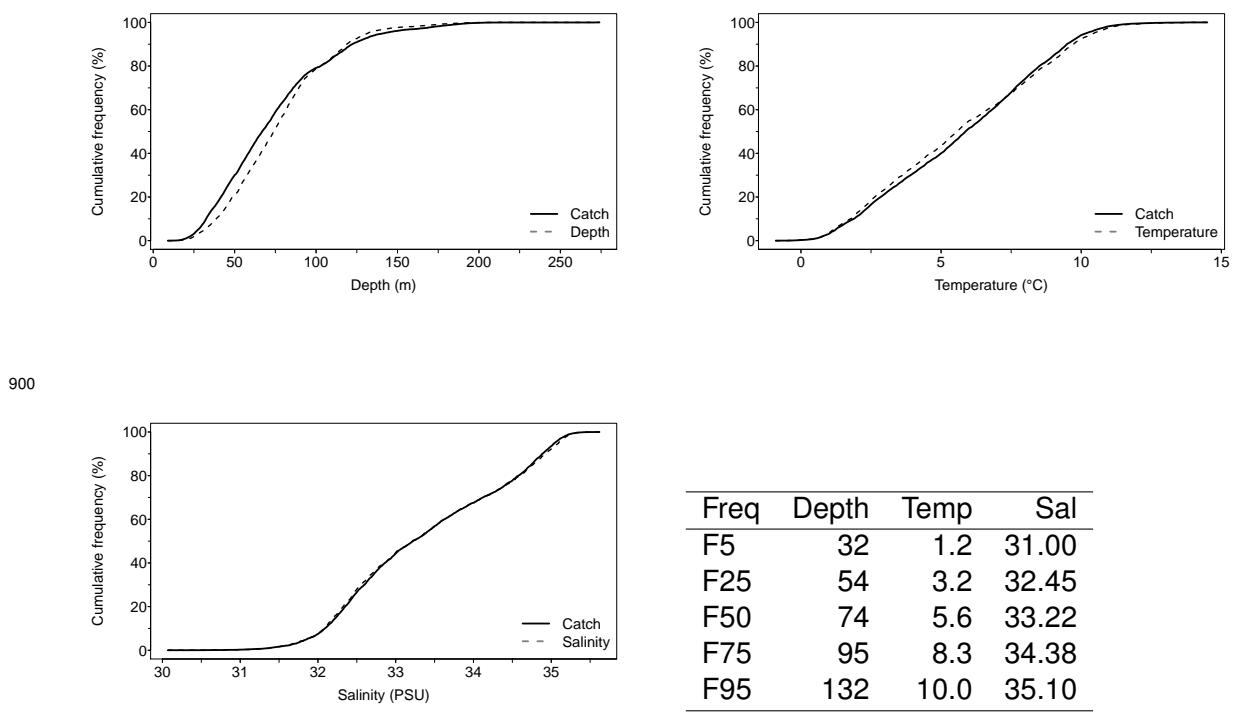


Figure 7.19E. Catch distribution by depth, temperature and salinity of Atlantic herring.

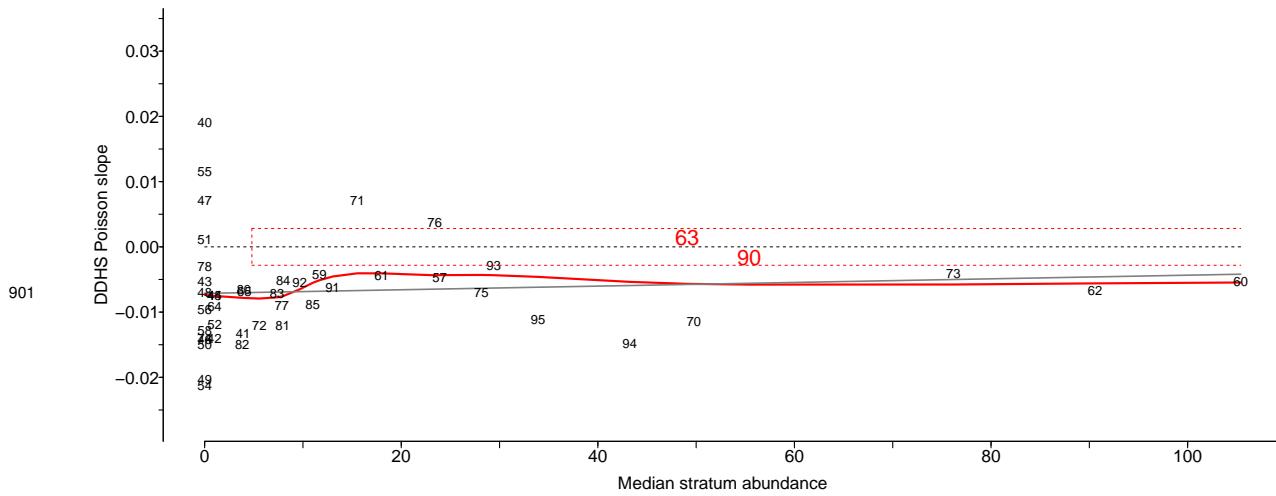


Figure 7.19F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic herring.

902

7.20 Monkfish (Baudroie d'Amérique) - species code 400 (category LF)

903

Scientific name: [Lophius americanus](#)

904

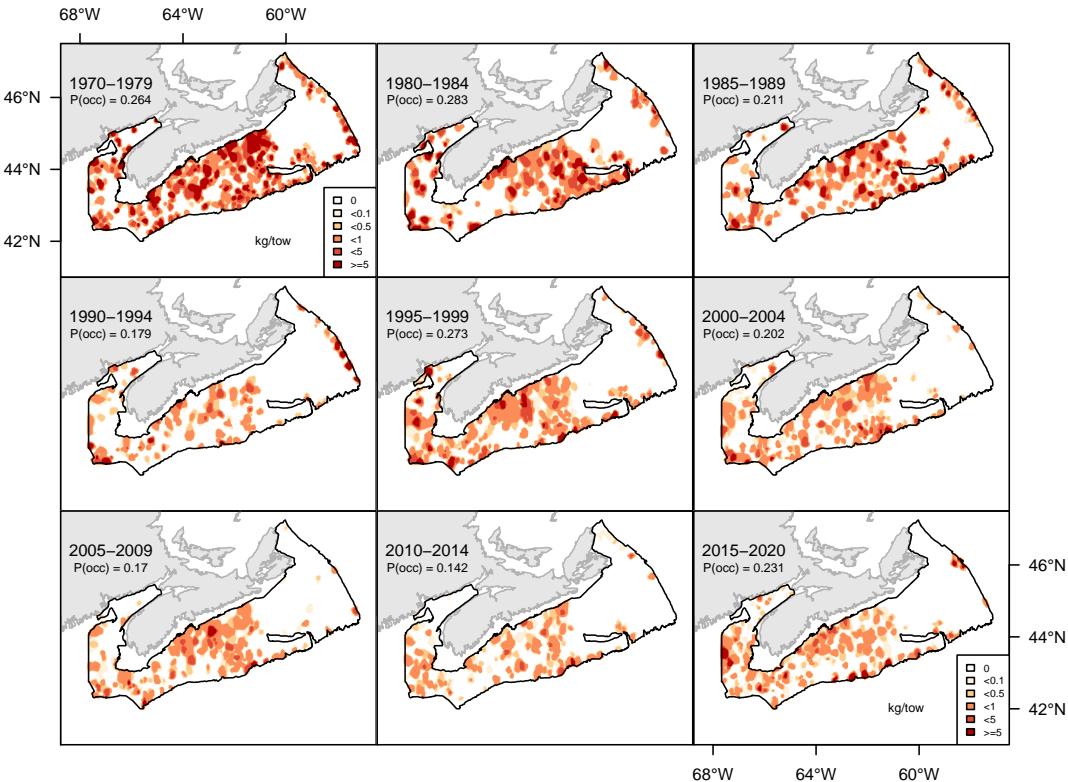


Figure 7.20A. Inverse distance weighted distribution of catch biomass (kg/tow) for Monkfish.

905

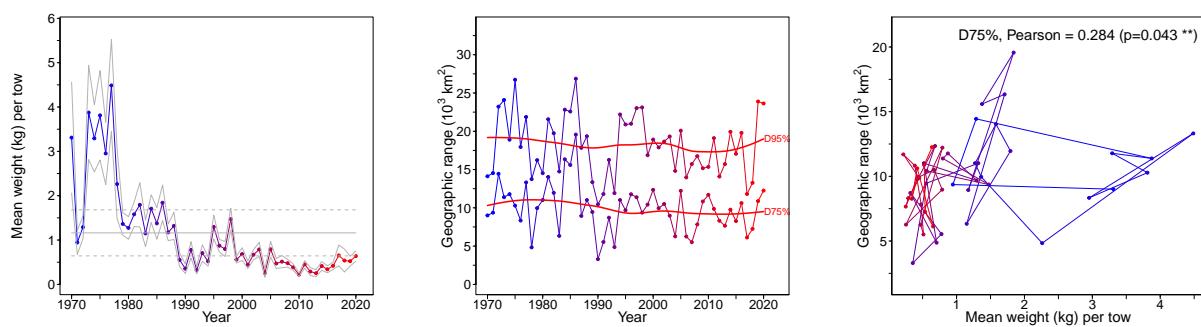


Figure 7.20B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Monkfish.

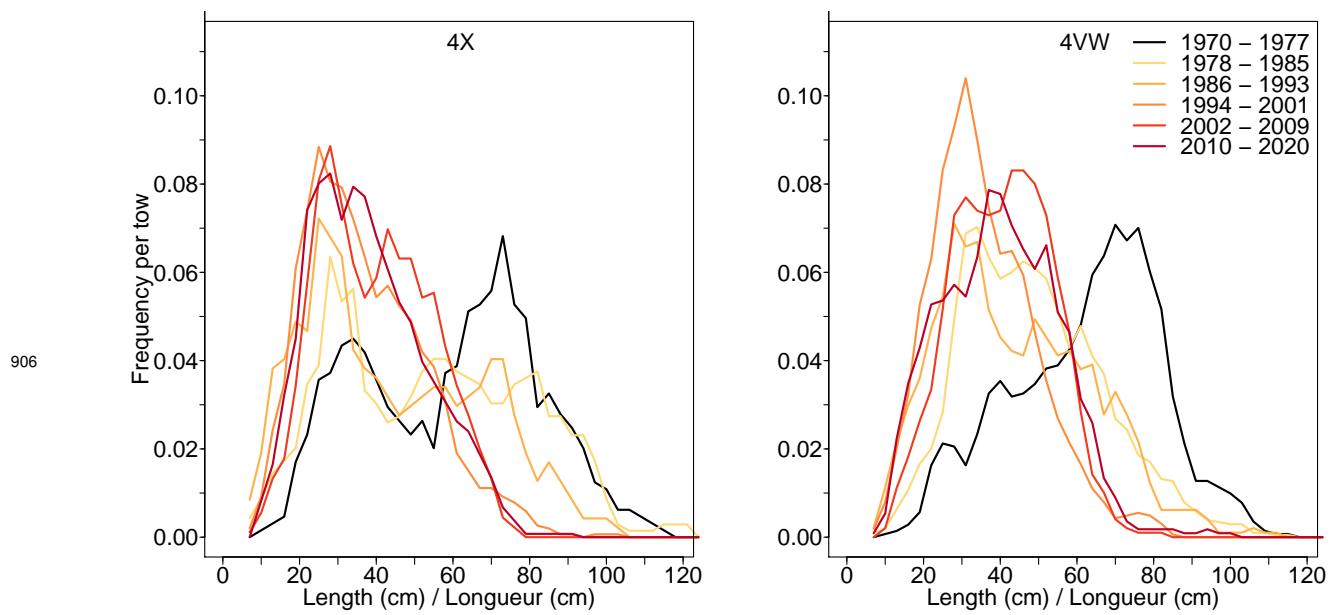


Figure 7.20C. Length frequency distribution in NAFO units 4X and 4VW for Monkfish.

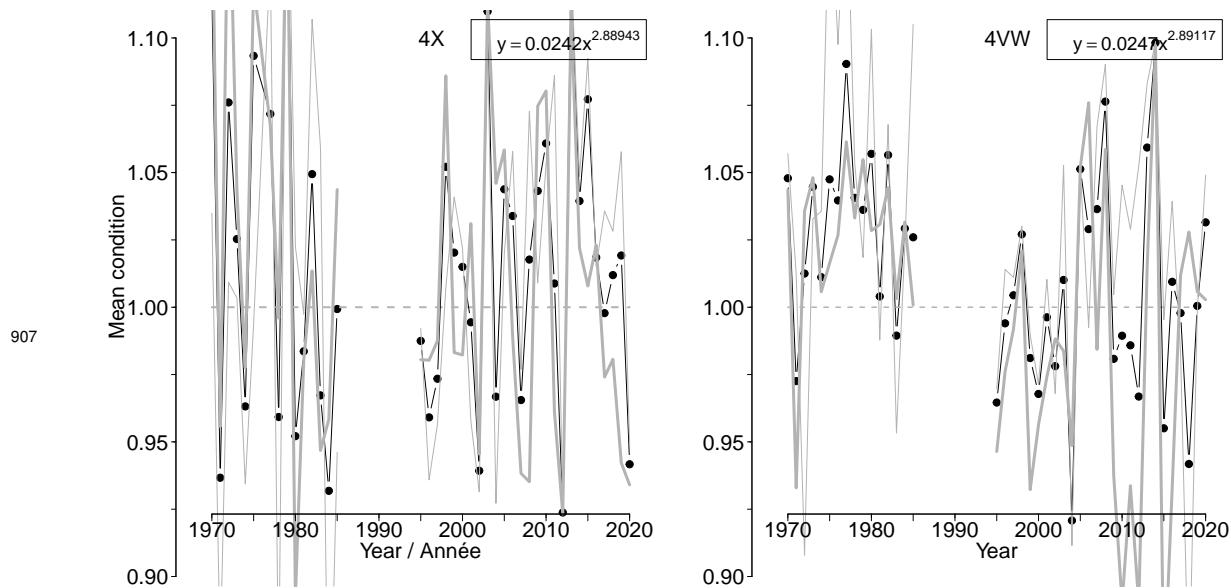
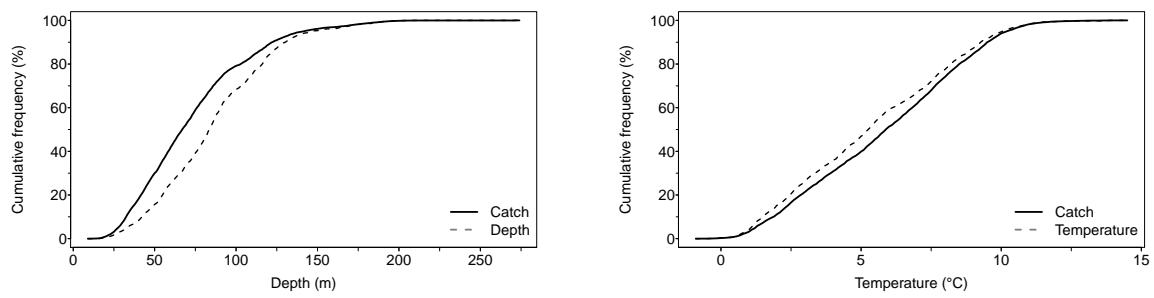
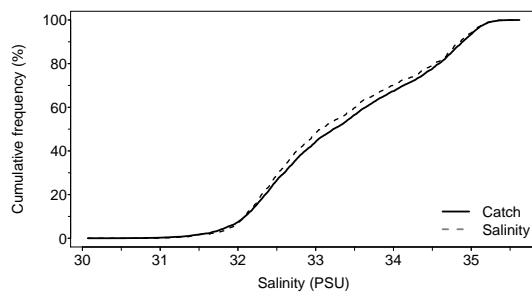


Figure 7.20D. Average fish condition in NAFO units 4X and 4VW for Monkfish.



908



Freq	Depth	Temp	Sal
F5	33	1.1	31.00
F25	60	2.9	32.43
F50	84	5.3	33.07
F75	110	7.8	34.31
F95	148	10.0	35.03

Figure 7.20E. Catch distribution by depth, temperature and salinity of Monkfish.

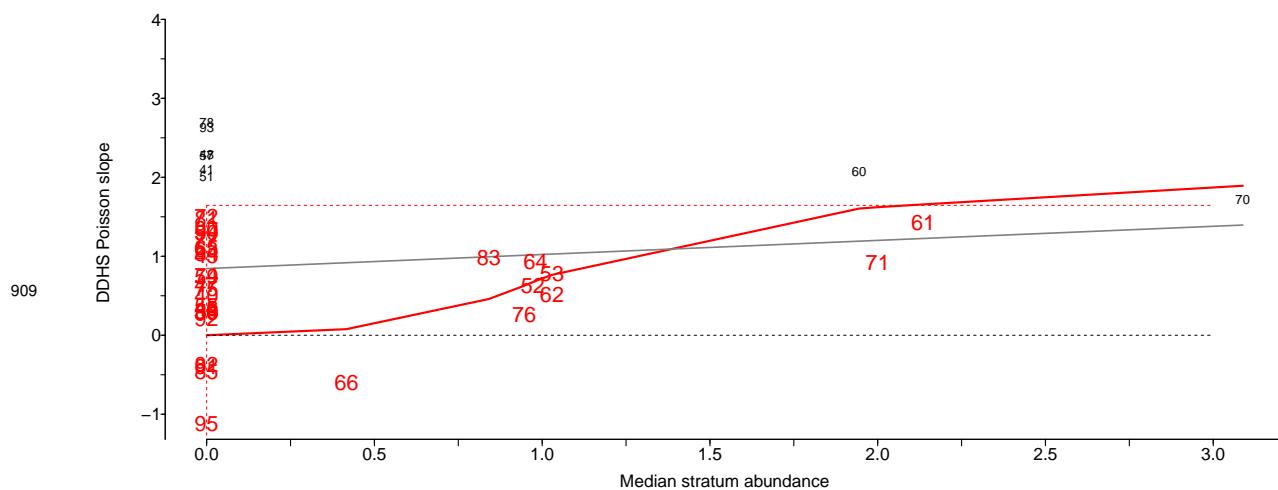


Figure 7.20F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Monkfish.

910

7.21 Thorny skate (Raie épineuse) - species code 201 (category LF)

911

Scientific name: [Amblyraja radiata](#)

912

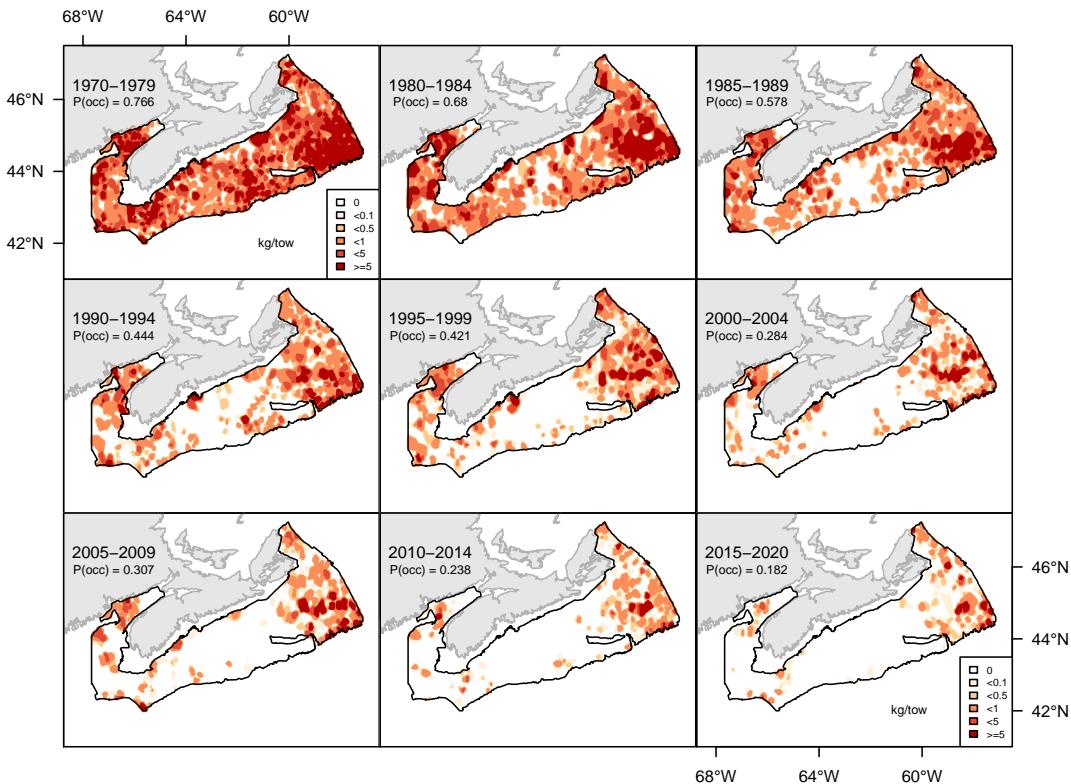


Figure 7.21A. Inverse distance weighted distribution of catch biomass (kg/tow) for Thorny skate.

913

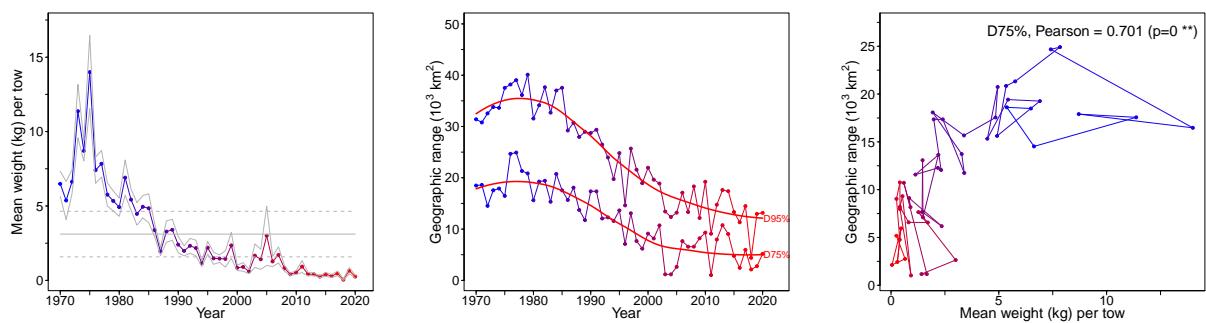


Figure 7.21B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Thorny skate.

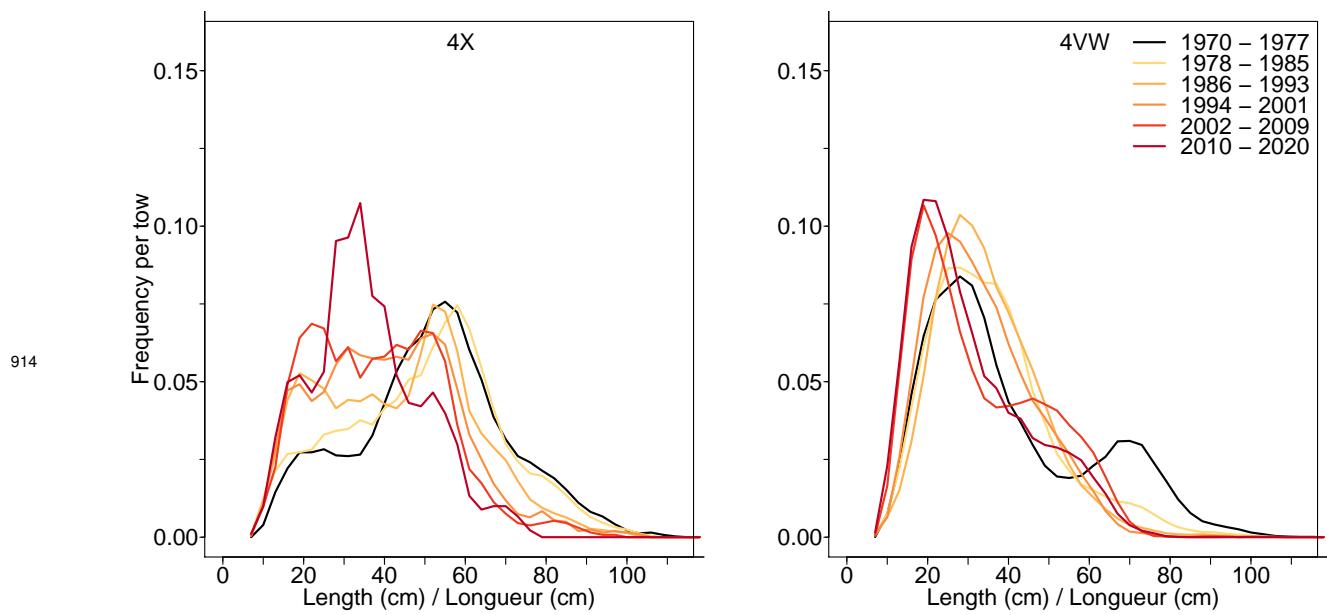


Figure 7.21C. Length frequency distribution in NAFO units 4X and 4VW for Thorny skate.

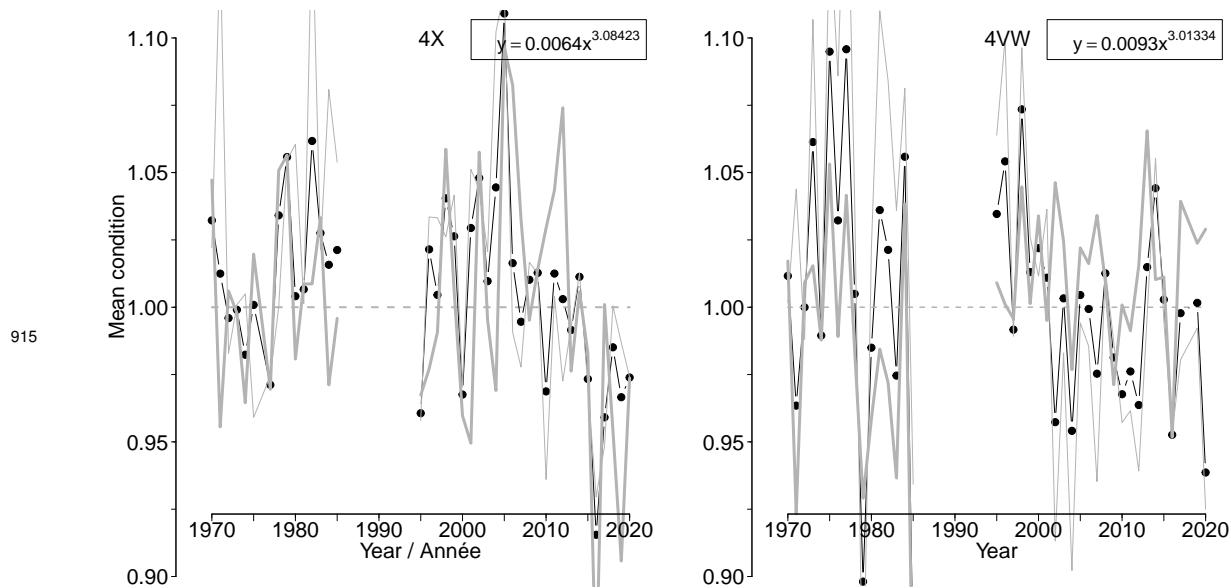
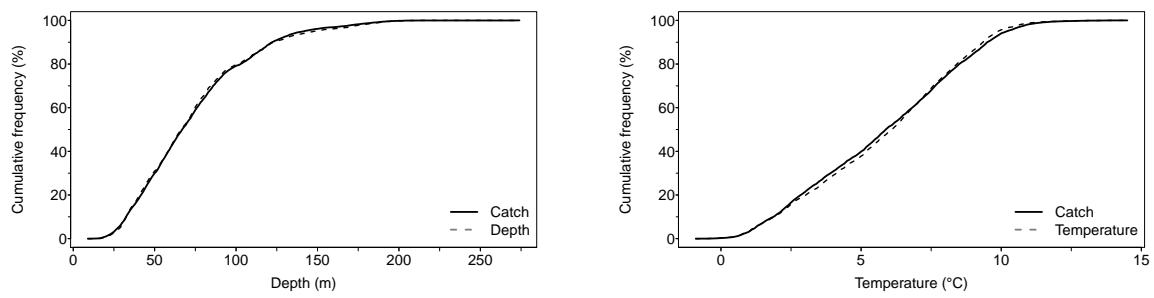
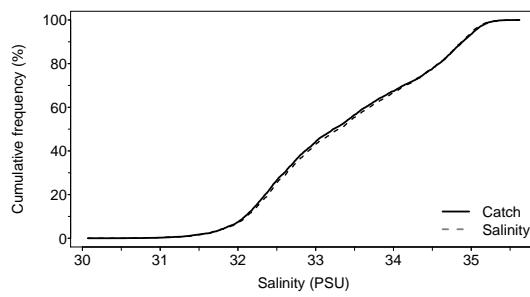


Figure 7.21D. Average fish condition in NAFO units 4X and 4VW for Thorny skate.



916



Freq	Depth	Temp	Sal
F5	29	1.3	31.00
F25	45	3.7	32.50
F50	67	6.2	33.30
F75	91	8.1	34.40
F95	148	9.9	35.03

Figure 7.21E. Catch distribution by depth, temperature and salinity of Thorny skate.

917

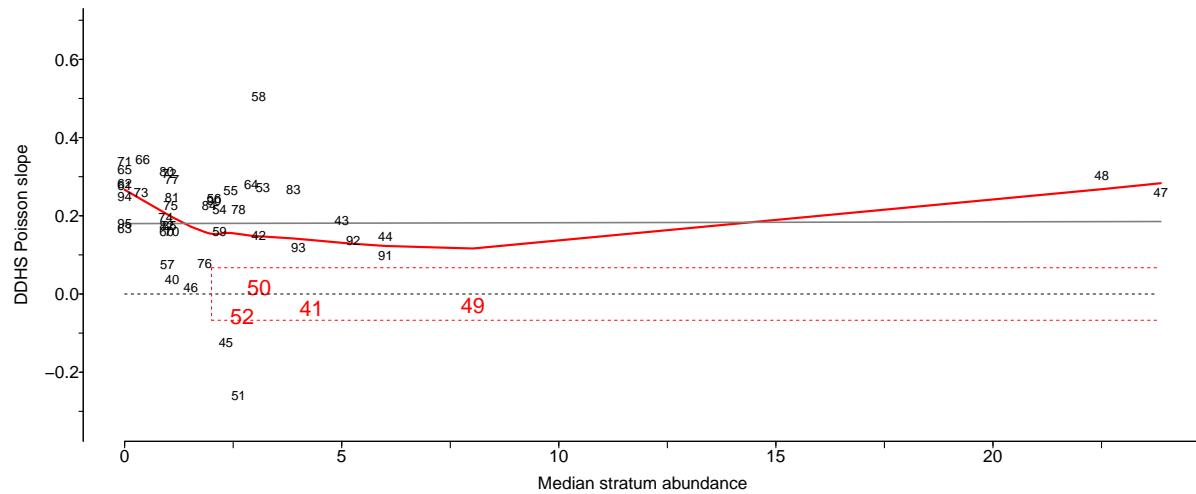


Figure 7.21F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Thorny skate.

918

7.22 Smooth skate (Raie lisse) - species code 202 (category LF)

919

Scientific name: [Malacoraja senta](#)

920

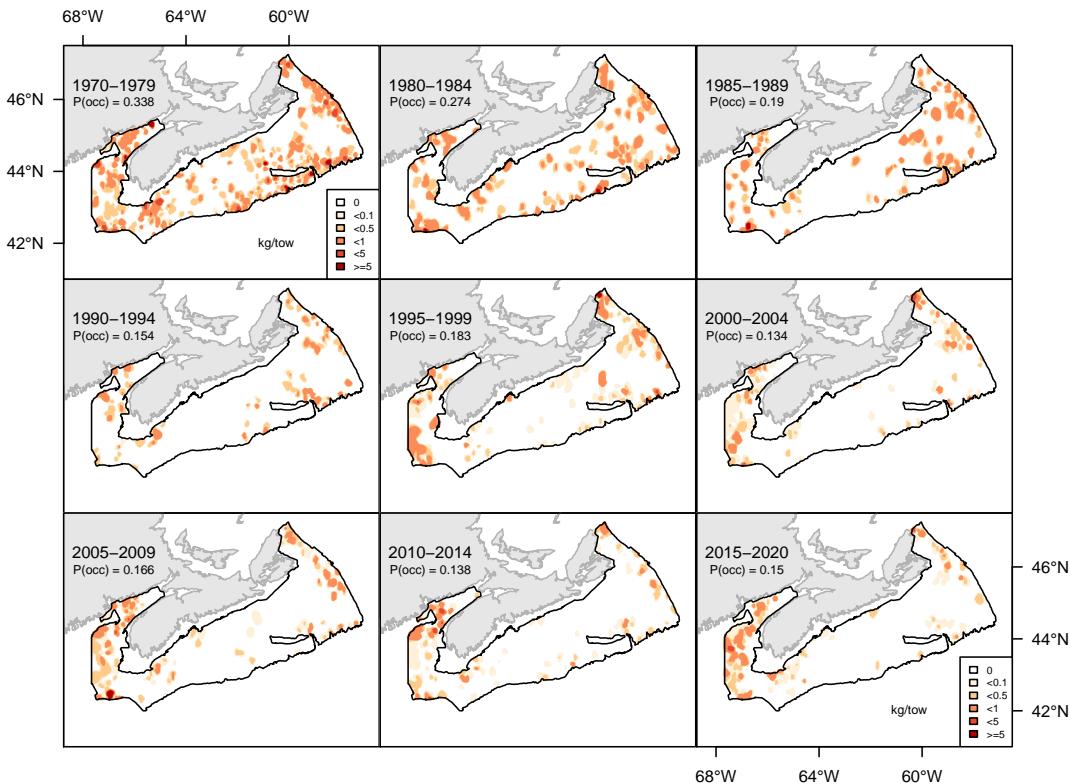


Figure 7.22A. Inverse distance weighted distribution of catch biomass (kg/tow) for Smooth skate.

921

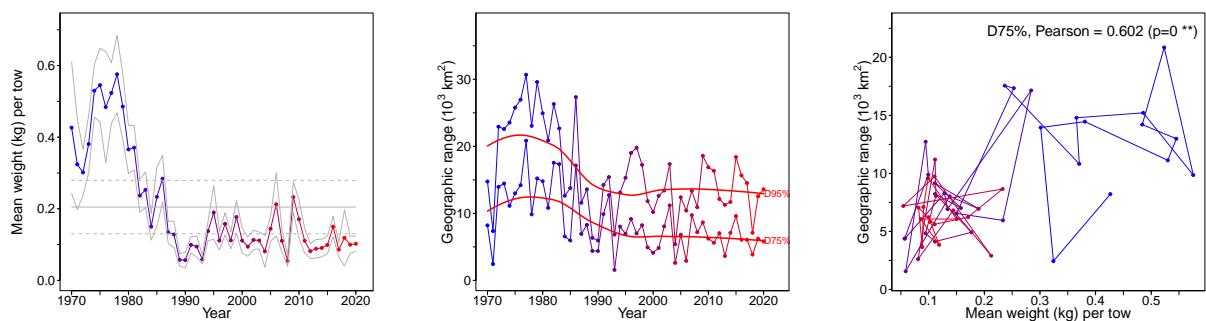


Figure 7.22B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Smooth skate.

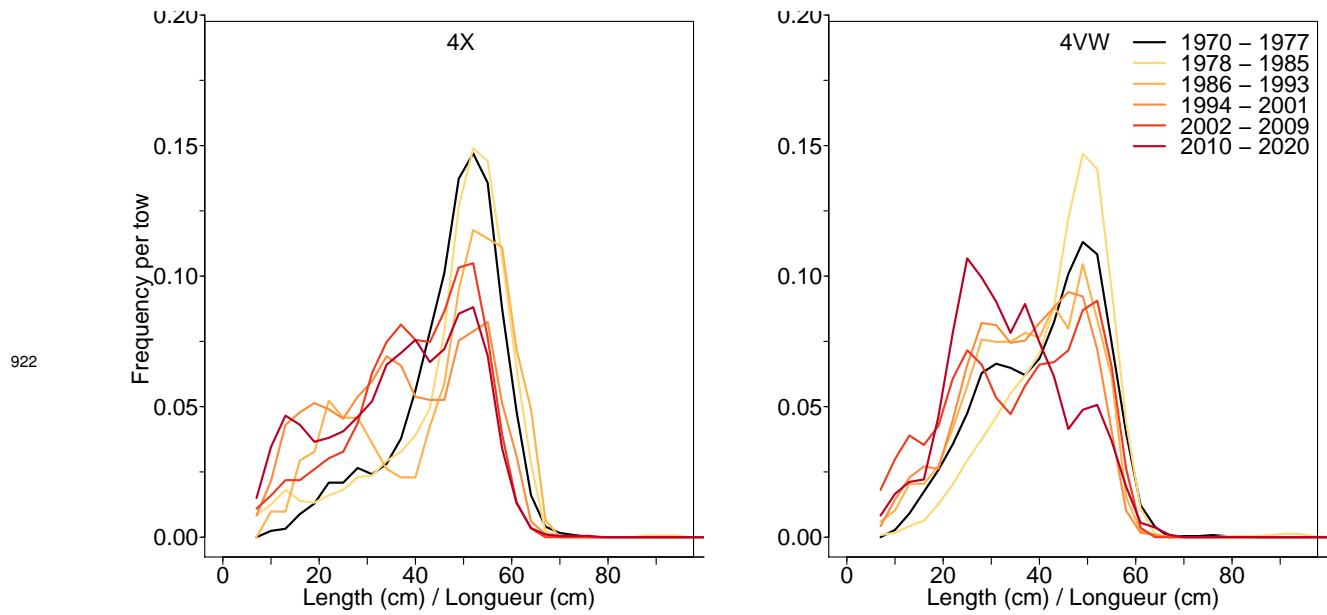


Figure 7.22C. Length frequency distribution in NAFO units 4X and 4VW for Smooth skate.

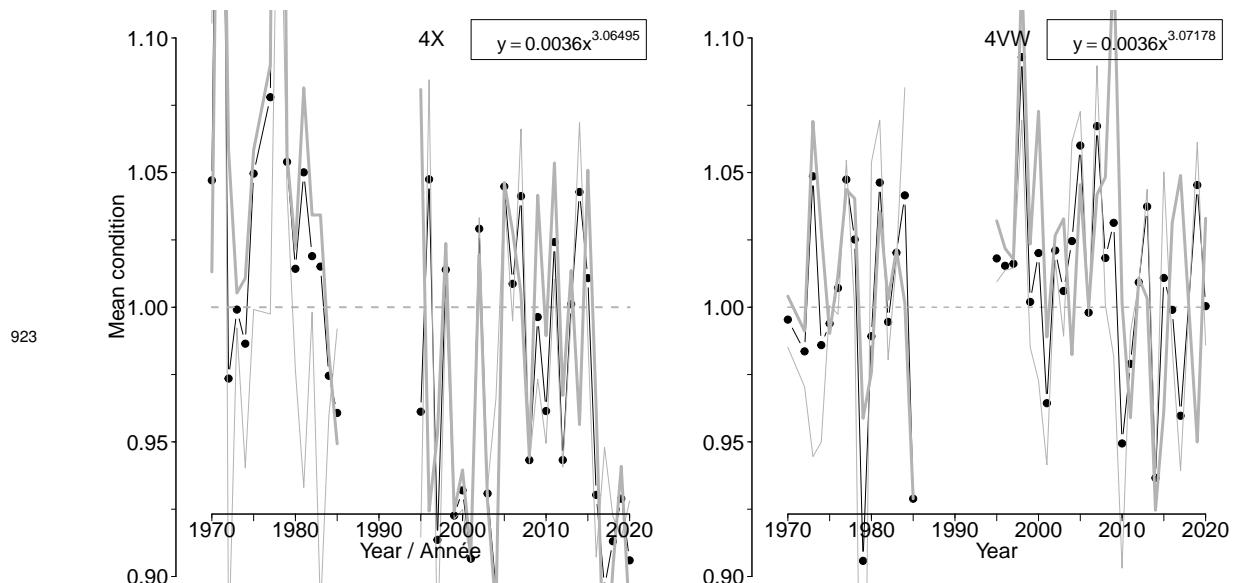
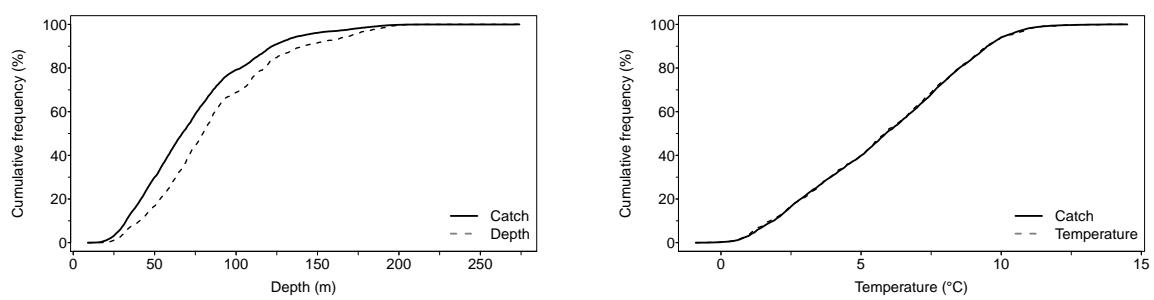
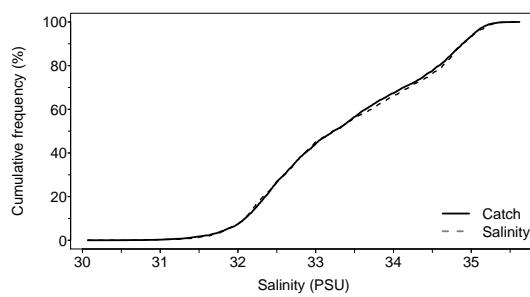


Figure 7.22D. Average fish condition in NAFO units 4X and 4VW for Smooth skate.



924



Freq	Depth	Temp	Sal
F5	33	1.2	31.00
F25	59	3.5	32.47
F50	80	5.9	33.23
F75	110	8.1	34.45
F95	171	10.0	35.06

Figure 7.22E. Catch distribution by depth, temperature and salinity of Smooth skate.

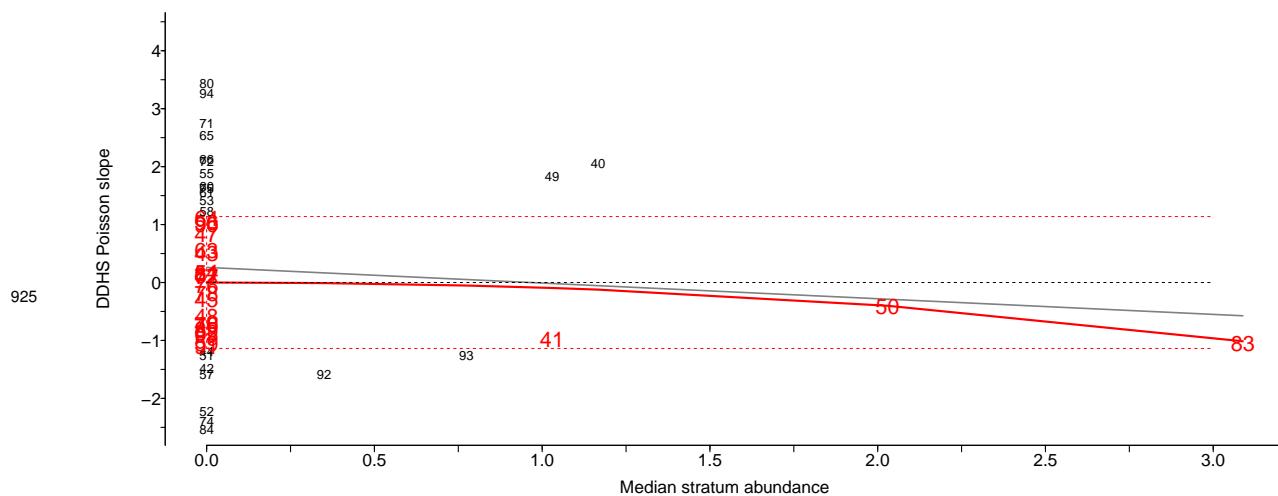


Figure 7.22F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Smooth skate.

926

7.23 Winter skate (Raie tachetée) - species code 204 (category LF)

927

Scientific name: [Leucoraja ocellata](#)

928

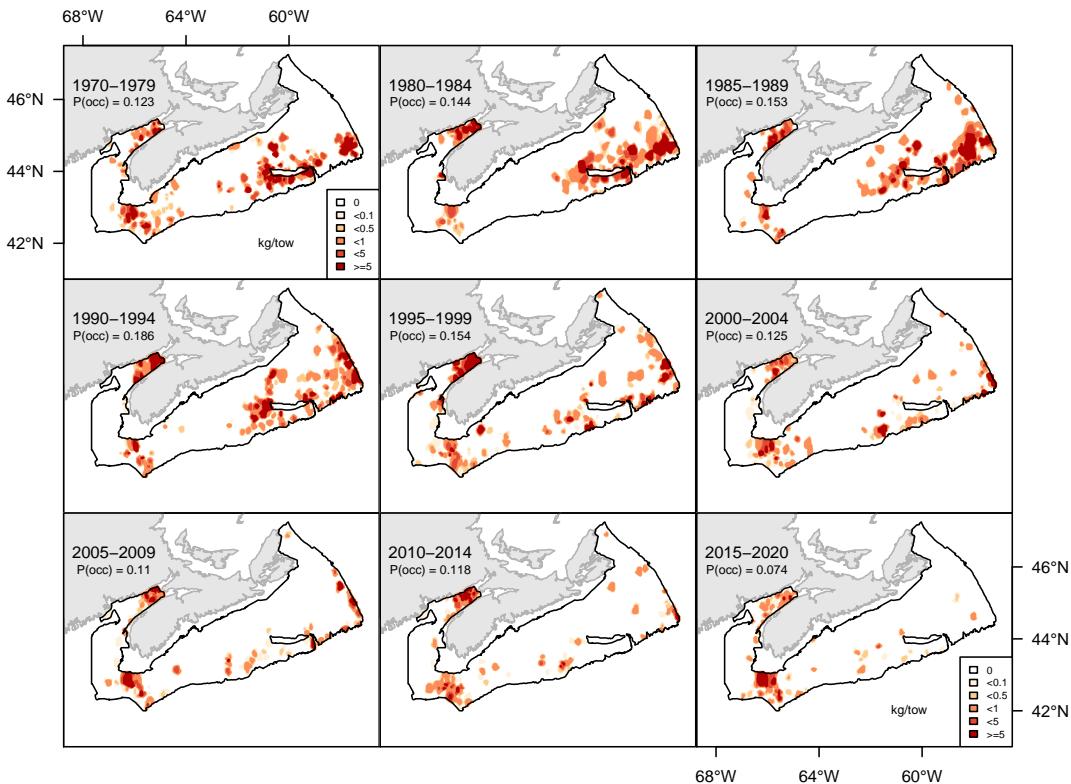


Figure 7.23A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter skate.

929

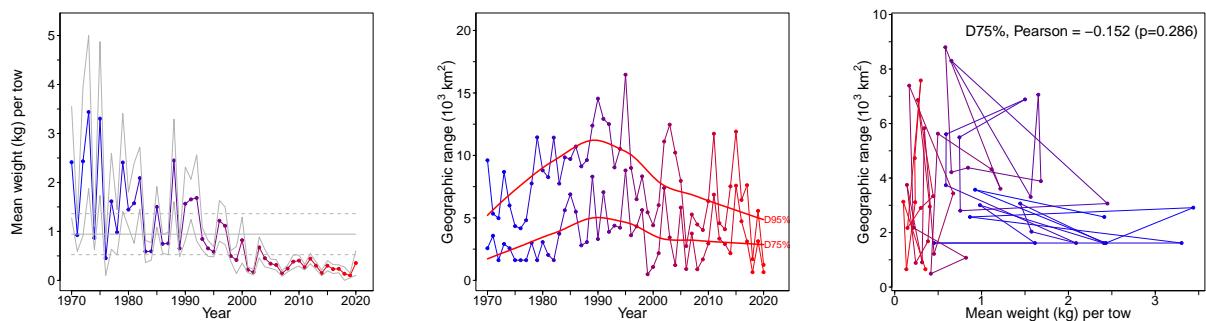


Figure 7.23B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter skate.

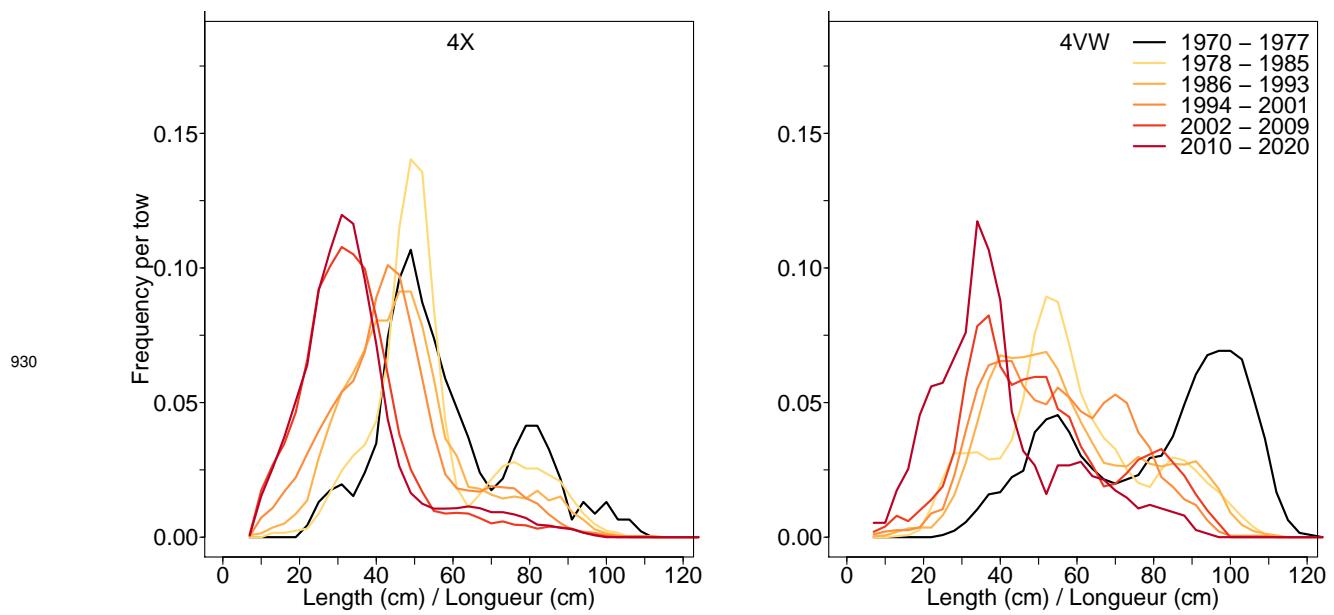


Figure 7.23C. Length frequency distribution in NAFO units 4X and 4VW for Winter skate.

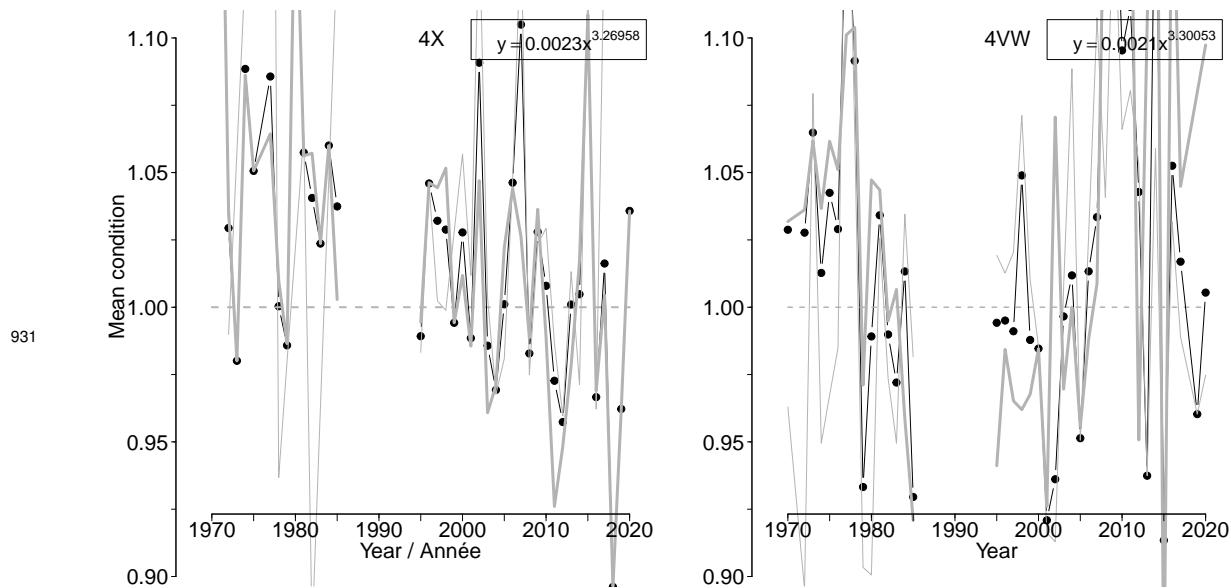
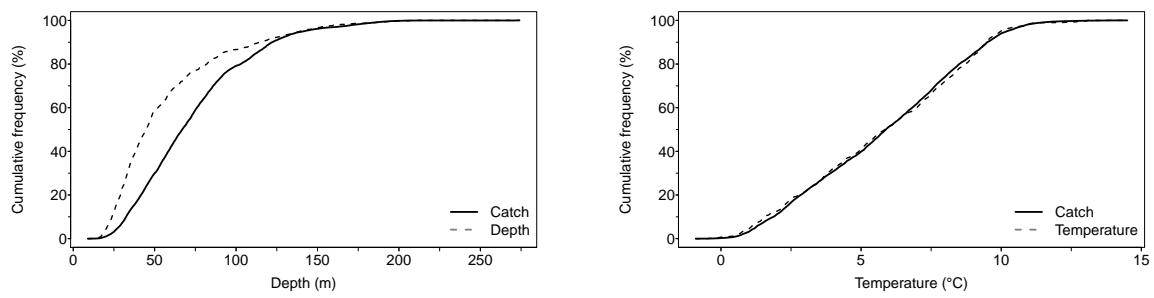
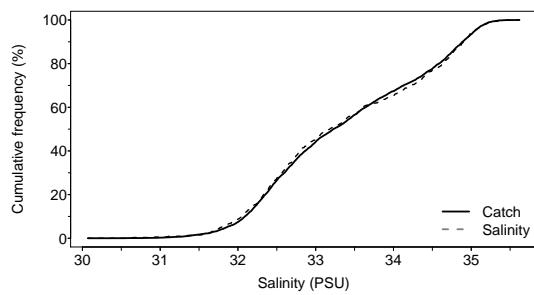


Figure 7.23D. Average fish condition in NAFO units 4X and 4VW for Winter skate.



932



Freq	Depth	Temp	Sal
F5	21	1.1	31.00
F25	32	3.5	32.44
F50	45	5.9	33.19
F75	71	8.3	34.42
F95	140	10.0	35.03

Figure 7.23E. Catch distribution by depth, temperature and salinity of Winter skate.

933

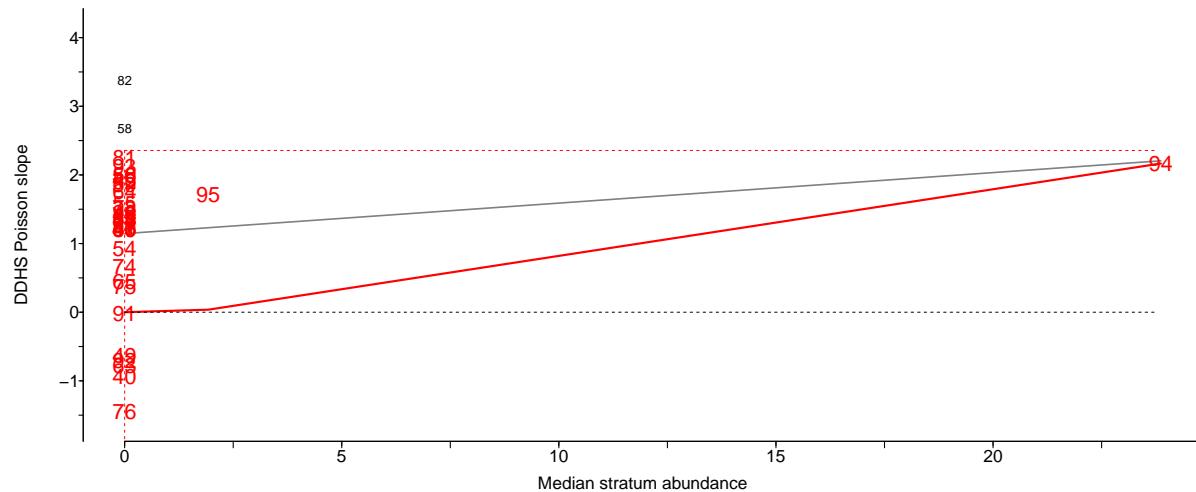


Figure 7.23F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter skate.

934 **7.24 Picked dogfish (Aiguillat commun) - species code 220 (category LF)**

935 Scientific name: [Squalus acanthias](#)

936

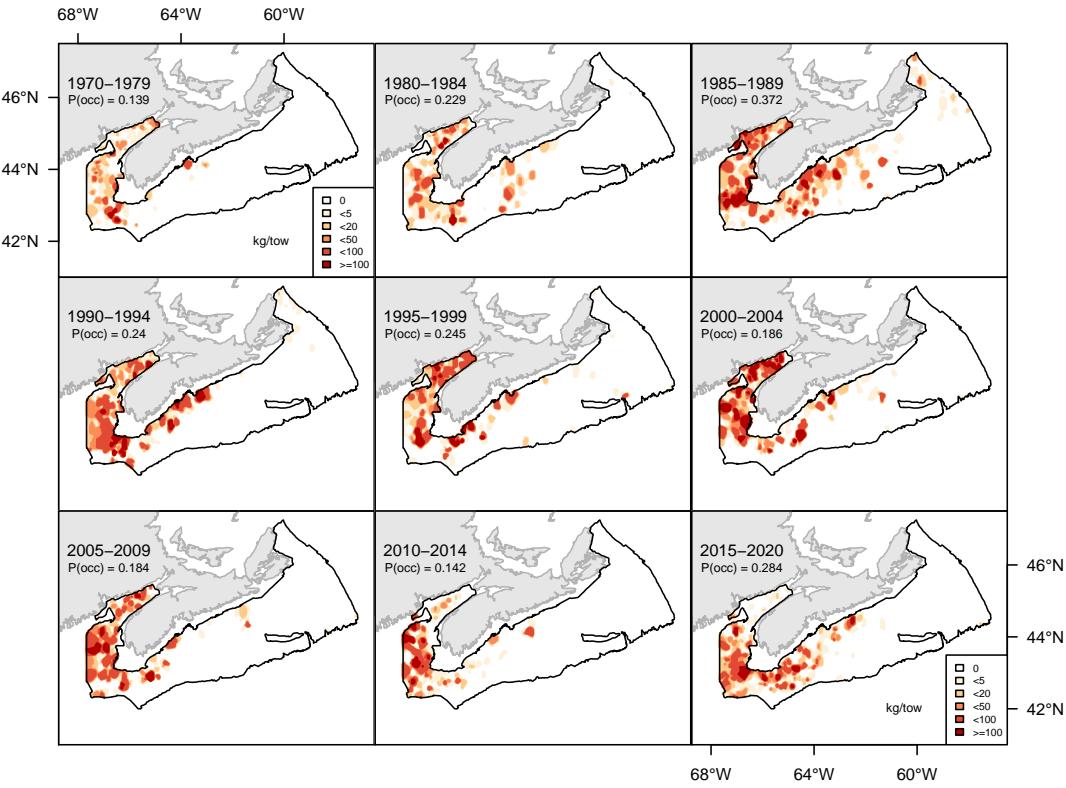


Figure 7.24A. Inverse distance weighted distribution of catch biomass (kg/tow) for Picked dogfish.

937

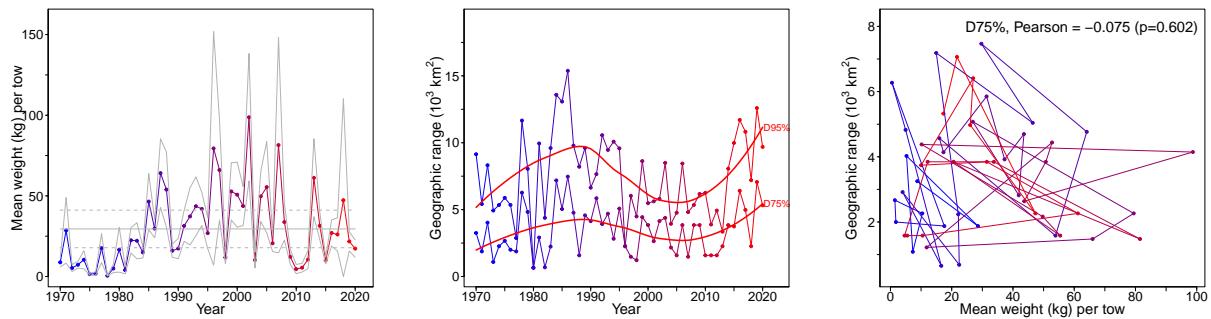


Figure 7.24B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Picked dogfish.

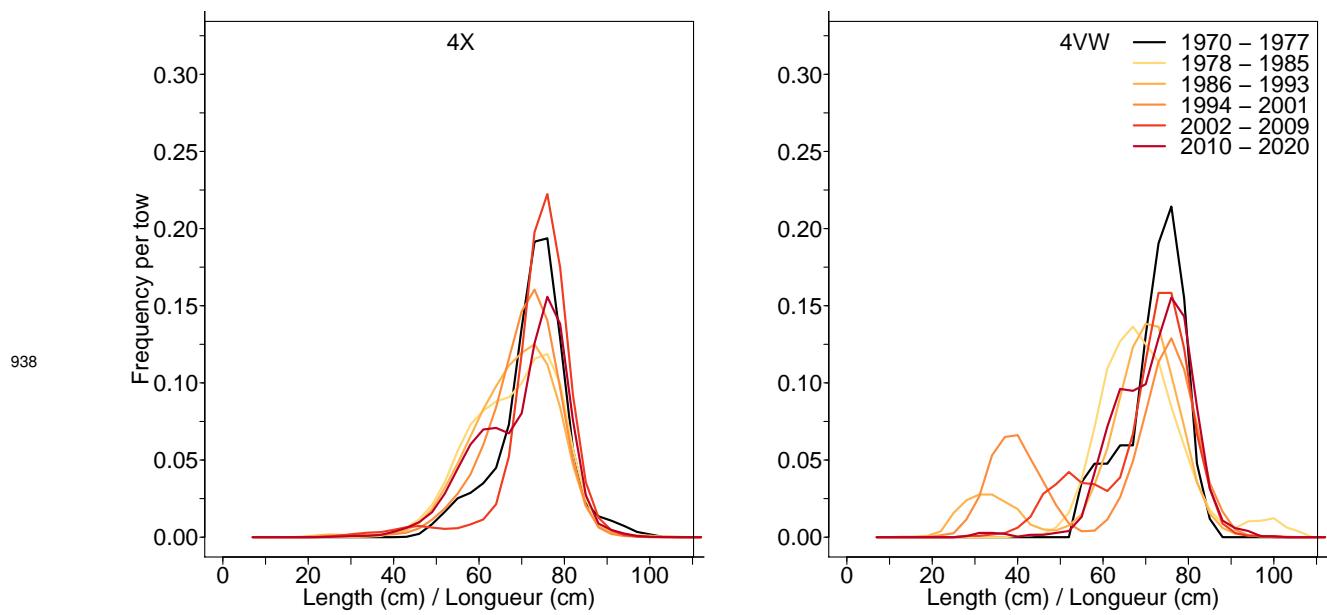


Figure 7.24C. Length frequency distribution in NAFO units 4X and 4VW for Picked dogfish.

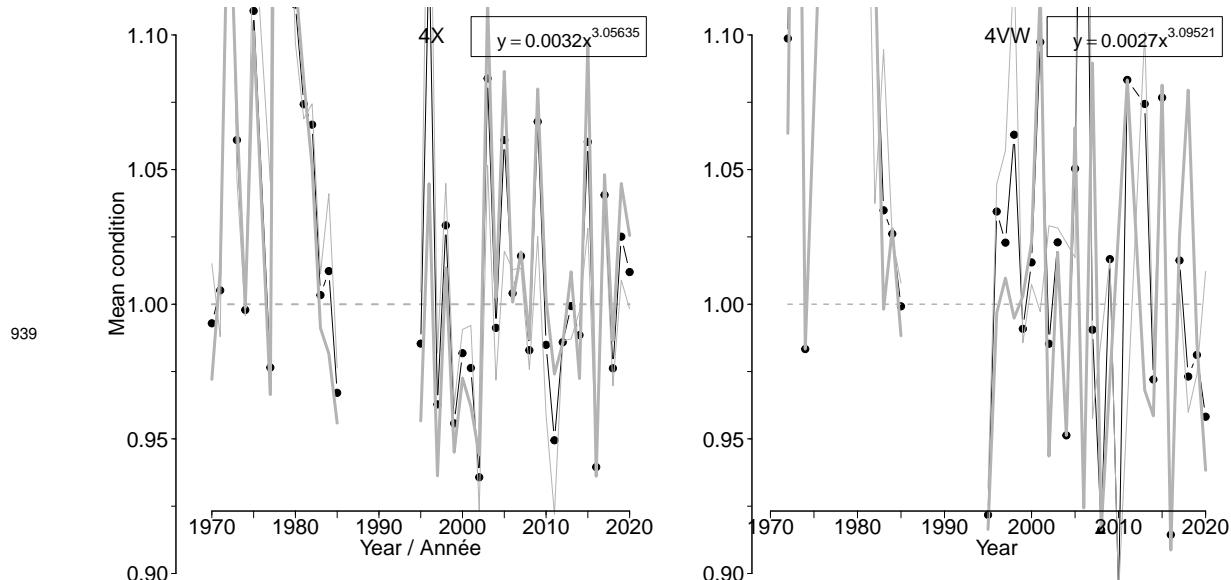
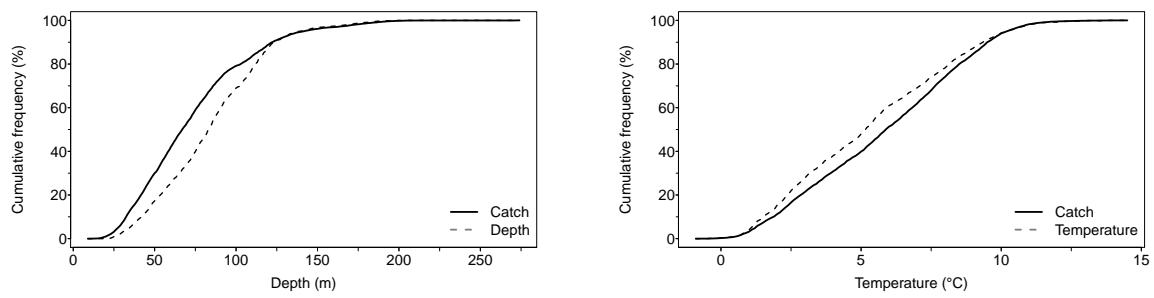
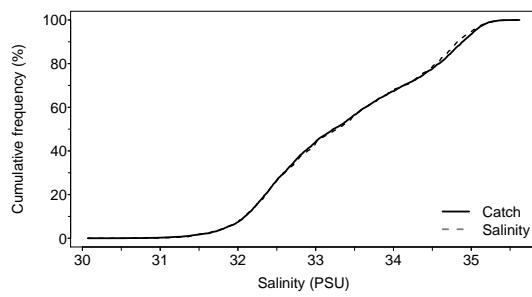


Figure 7.24D. Average fish condition in NAFO units 4X and 4VW for Picked dogfish.



940



Freq	Depth	Temp	Sal
F5	35	1.1	31.00
F25	60	2.8	32.47
F50	83	5.2	33.28
F75	108	7.7	34.37
F95	139	10.0	35.02

Figure 7.24E. Catch distribution by depth, temperature and salinity of Picked dogfish.

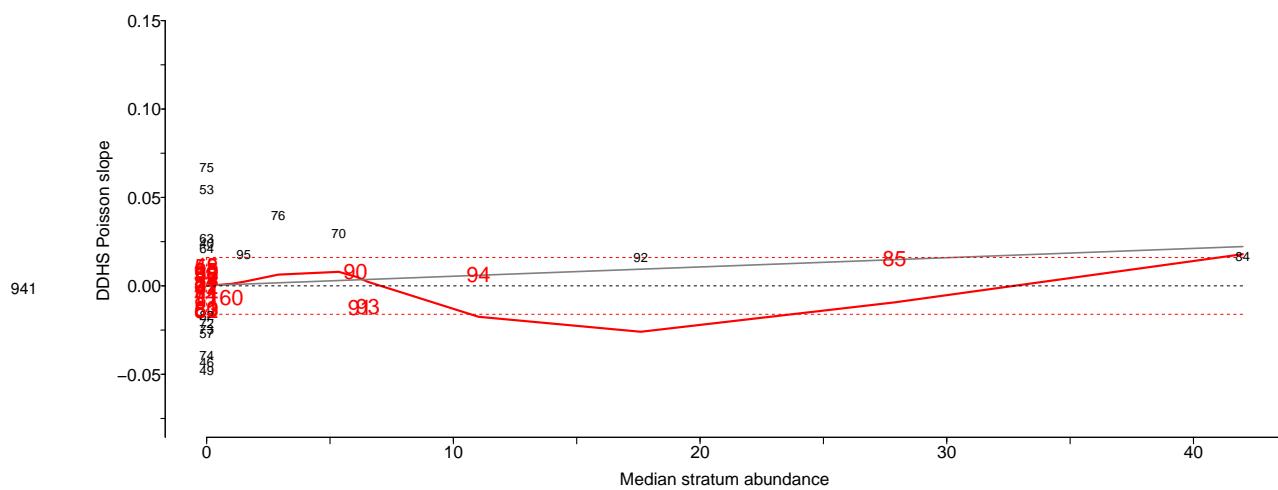


Figure 7.24F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Picked dogfish.

942 **7.25 Northern shortfin squid (*Encornet rouge nordique*) - species code 4511 (category
943 LF)**

944 Scientific name: [Illex illecebrosus](#)

945

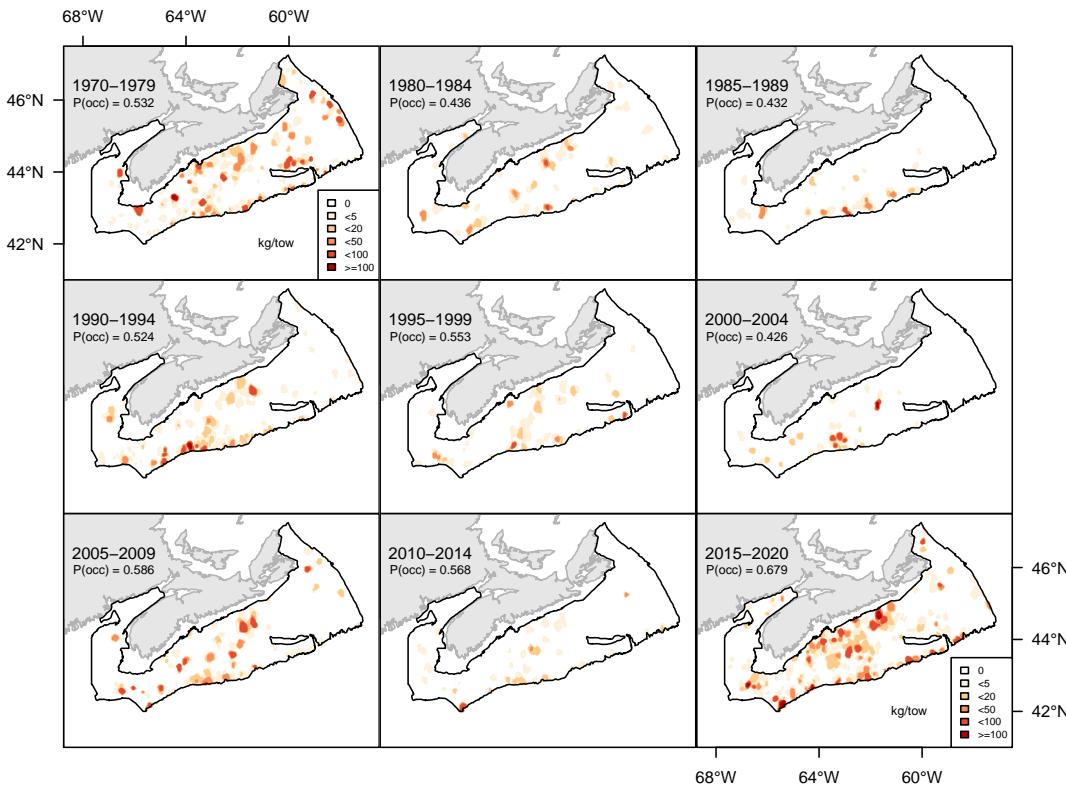


Figure 7.25A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern shortfin squid.

946

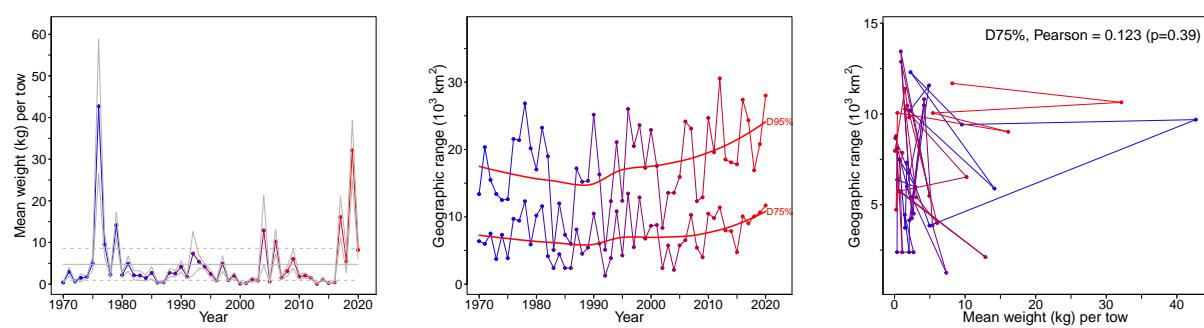


Figure 7.25B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern shortfin squid.

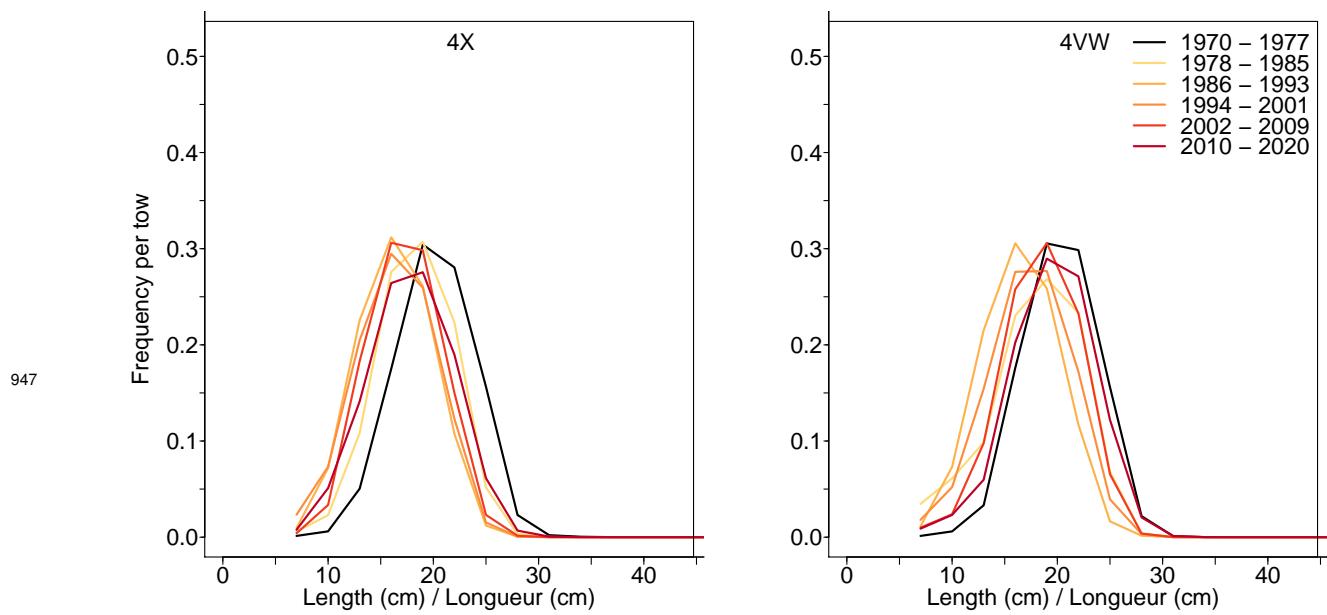


Figure 7.25C. Length frequency distribution in NAFO units 4X and 4VW for Northern shortfin squid.

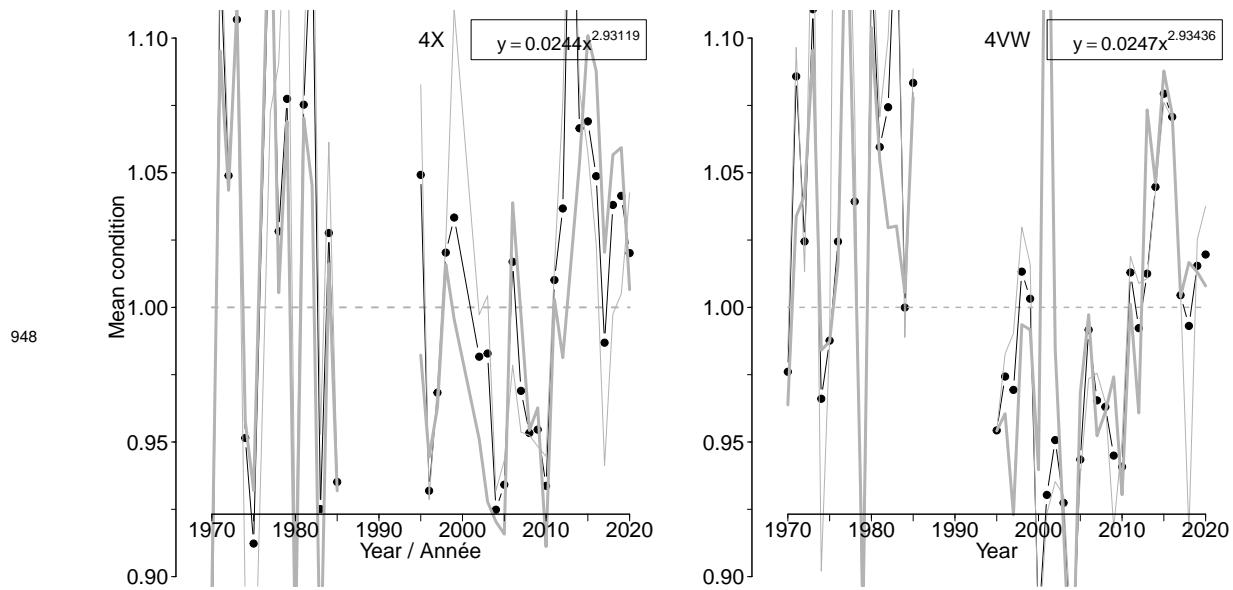
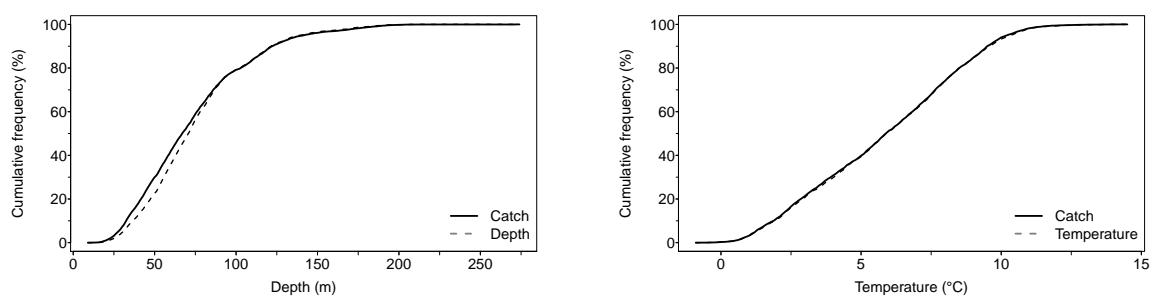
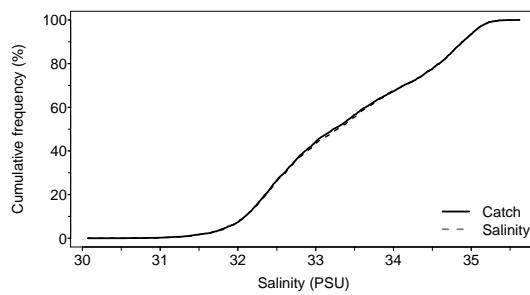


Figure 7.25D. Average fish condition in NAFO units 4X and 4VW for Northern shortfin squid.



949



Freq	Depth	Temp	Sal
F5	31	1.3	31.00
F25	53	3.5	32.48
F50	71	5.9	33.28
F75	93	8.1	34.39
F95	139	10.0	35.05

Figure 7.25E. Catch distribution by depth, temperature and salinity of Northern shortfin squid.

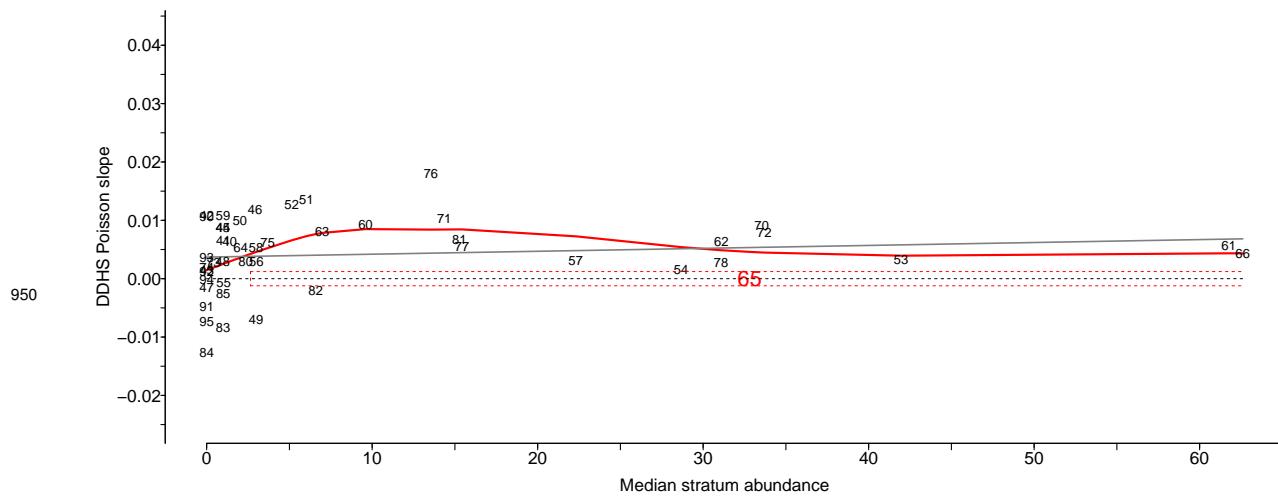


Figure 7.25F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Northern shortfin squid.

951

7.26 Atlantic hagfish (*Myxine du nord*) - species code 241 (category LI)

952

Scientific name: [Myxine glutinosa](#)

953

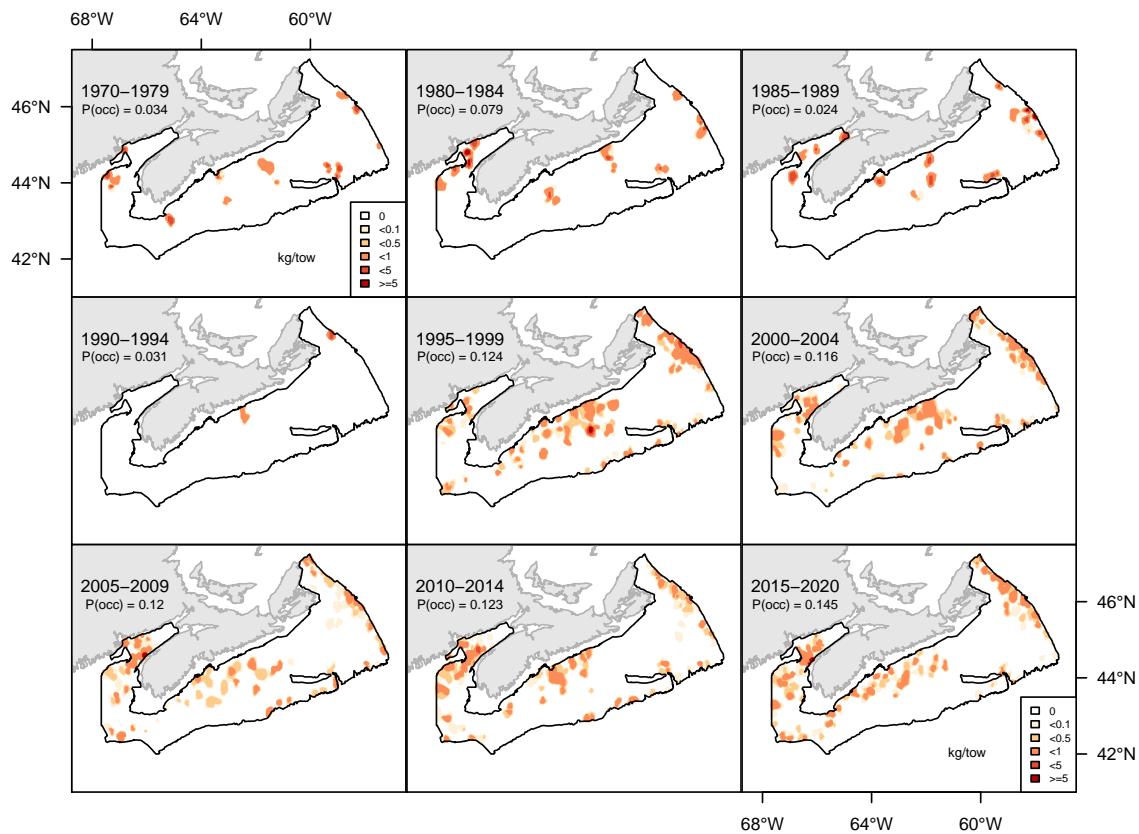


Figure 7.26A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic hagfish.

954

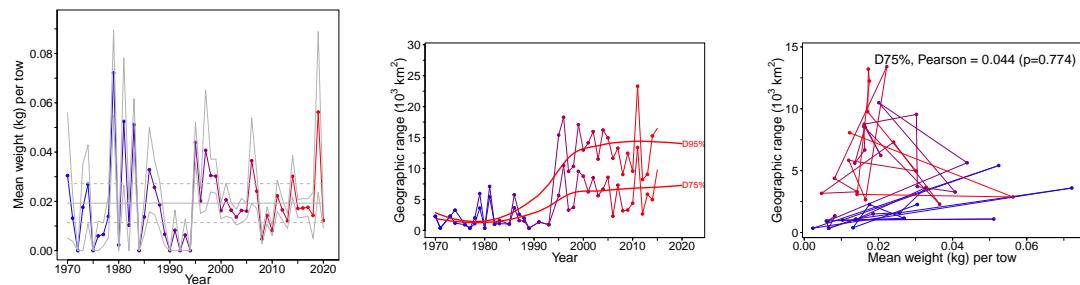


Figure 7.26B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hagfish.

955

7.27 Cusk (Brosme) - species code 15 (category LI)

956

Scientific name: [Brosme brosme](#)

957

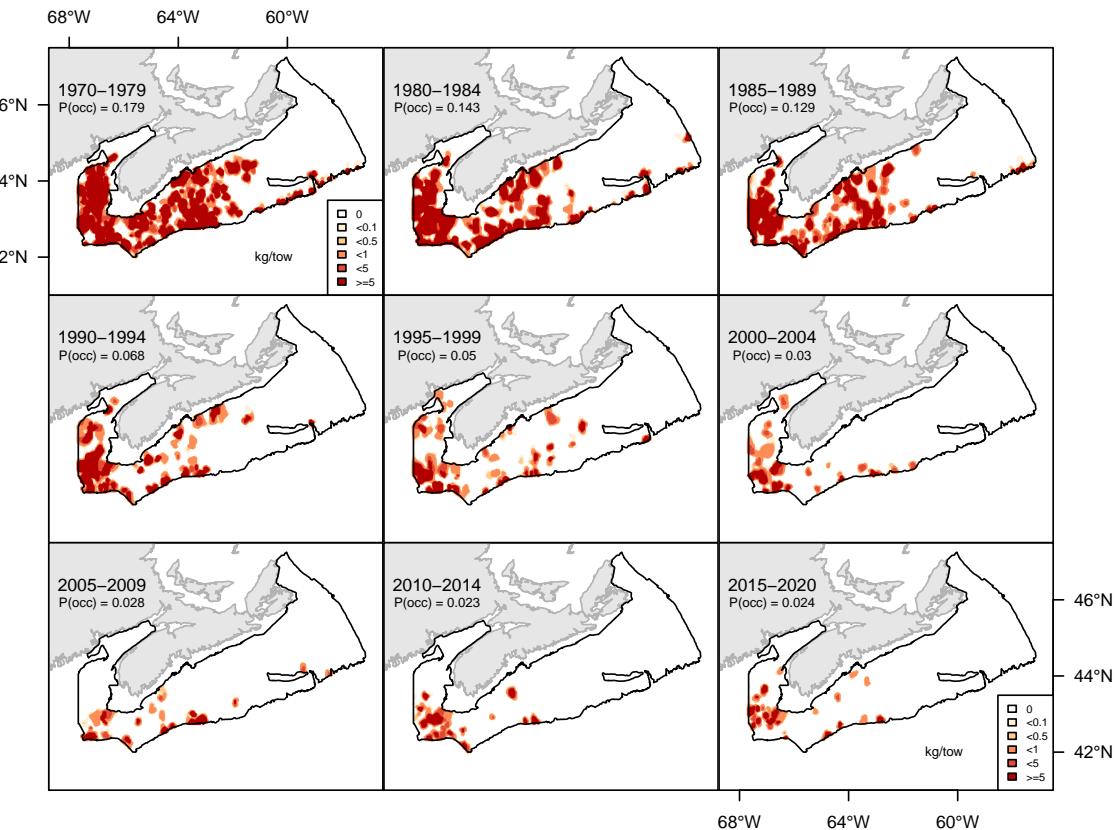


Figure 7.27A. Inverse distance weighted distribution of catch biomass (kg/tow) for Cusk.

958

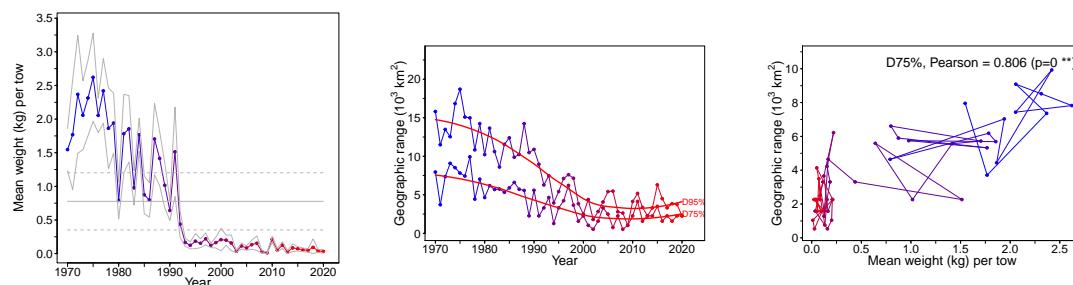


Figure 7.27B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Cusk.

959 **7.28 Longfin hake (*Merluche à longues nageoires*) - species code 112 (category LI)**

960 Scientific name: [Phycis chesteri](#)

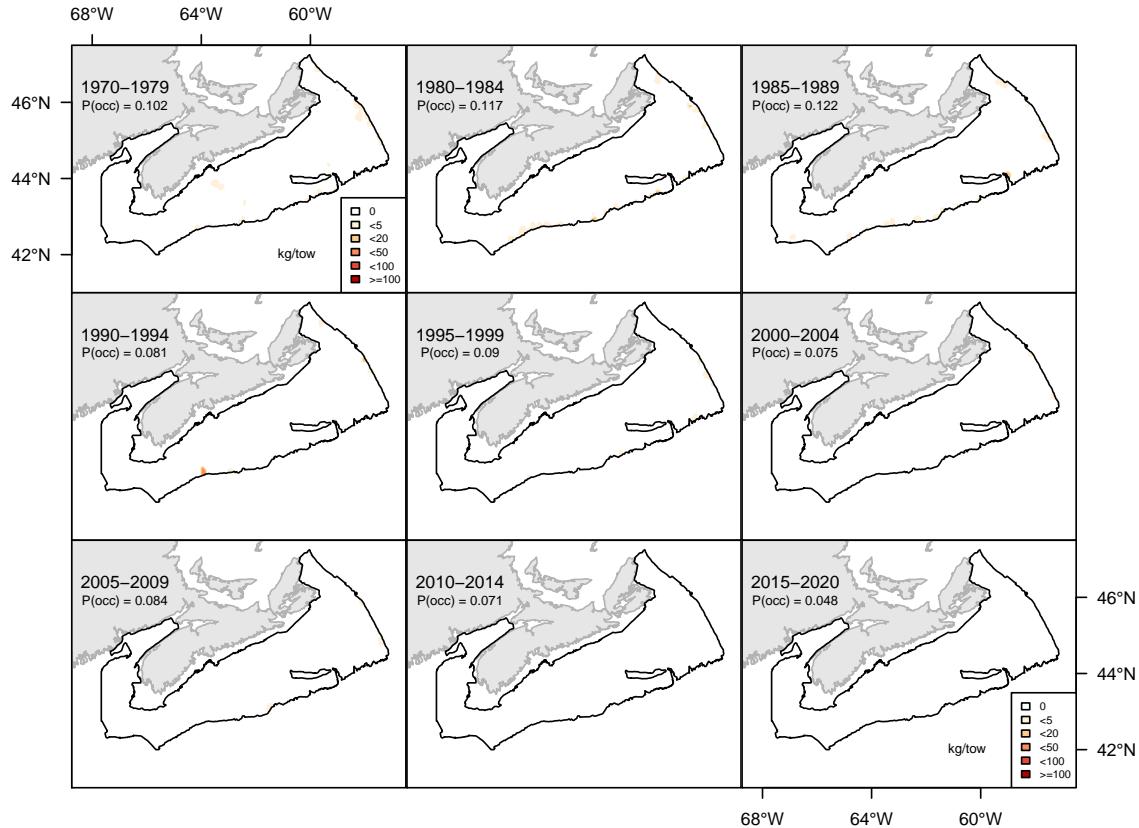


Figure 7.28A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longfin hake.

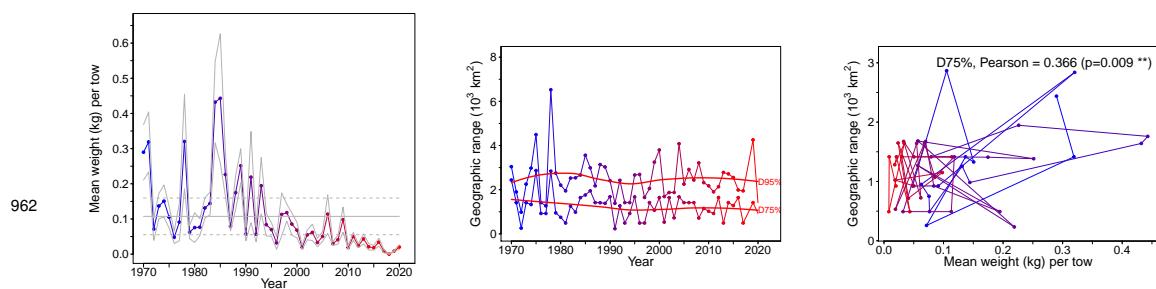


Figure 7.28B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longfin hake.

963 **7.29 Fourbeard rockling (Motelle à quatre barbillons) - species code 114 (category LI)**

964 Scientific name: [Enchelyopus cimbrius](#)

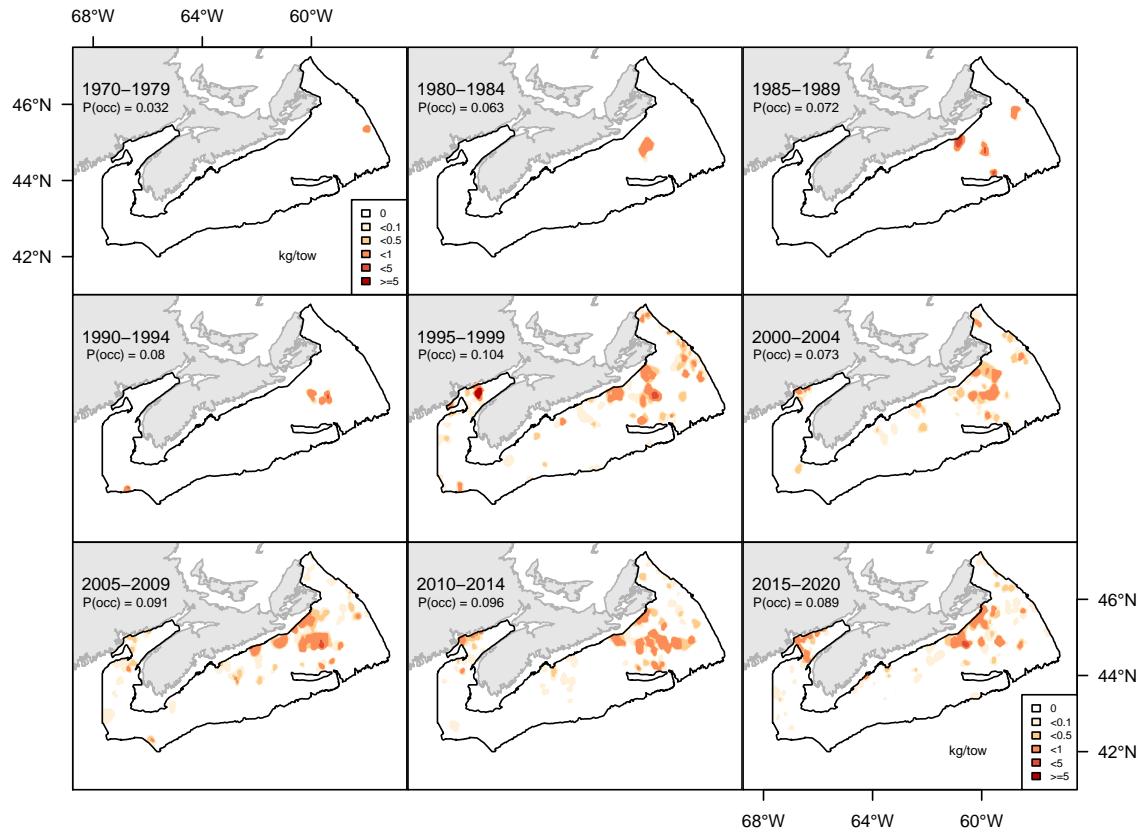


Figure 7.29A. Inverse distance weighted distribution of catch biomass (kg/tow) for Fourbeard rockling.

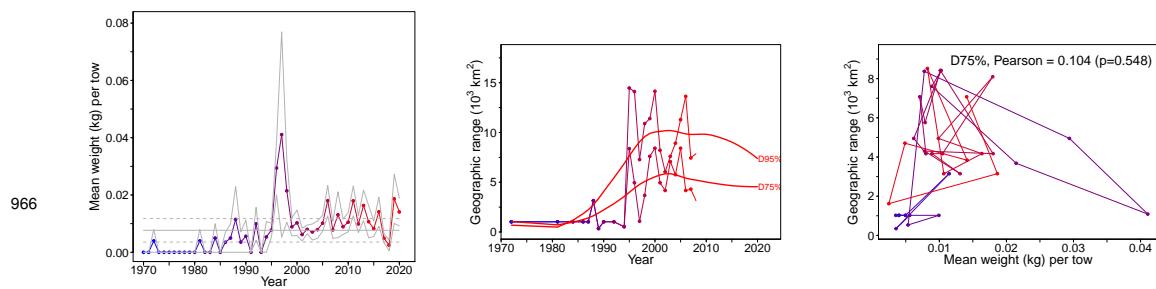


Figure 7.29B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Fourbeard rockling.

967 **7.30 Marlin-spike grenadier (Grenadier du Grand Banc) - species code 410 (category**
 968 **LI)**

969 Scientific name: [Nezumia bairdii](#)

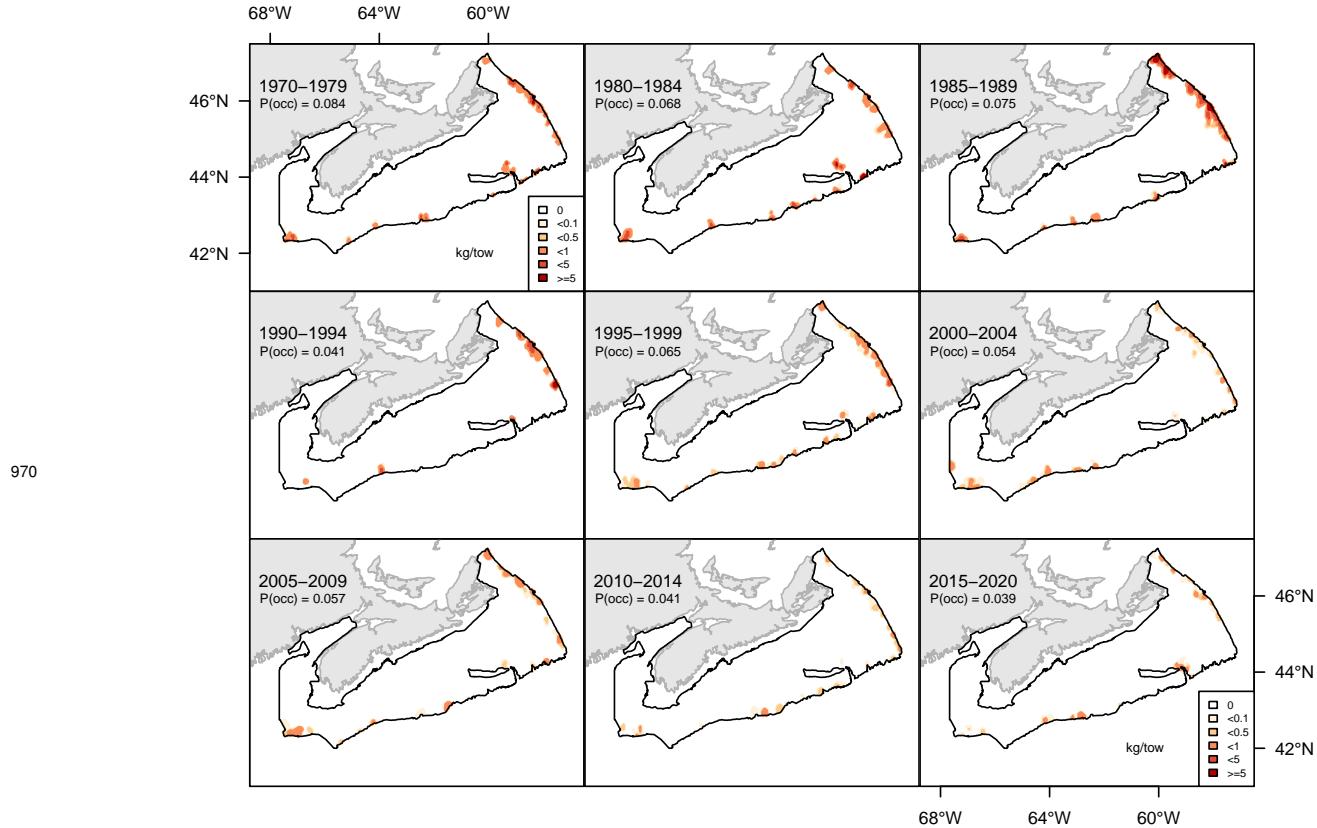


Figure 7.30A. Inverse distance weighted distribution of catch biomass (kg/tow) for Marlin-spike grenadier.

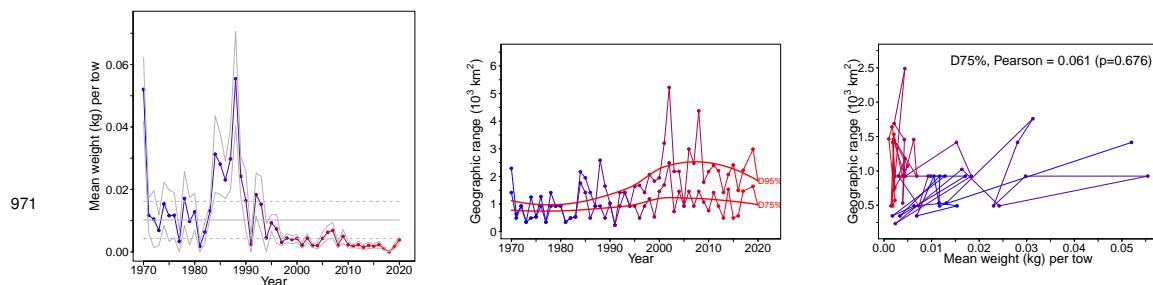


Figure 7.30B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Marlin-spike grenadier.

972

7.31 Blackbelly rosefish (Sébaste chèvre) - species code 123 (category LI)

973

Scientific name: [Helicolenus dactylopterus](#)

974

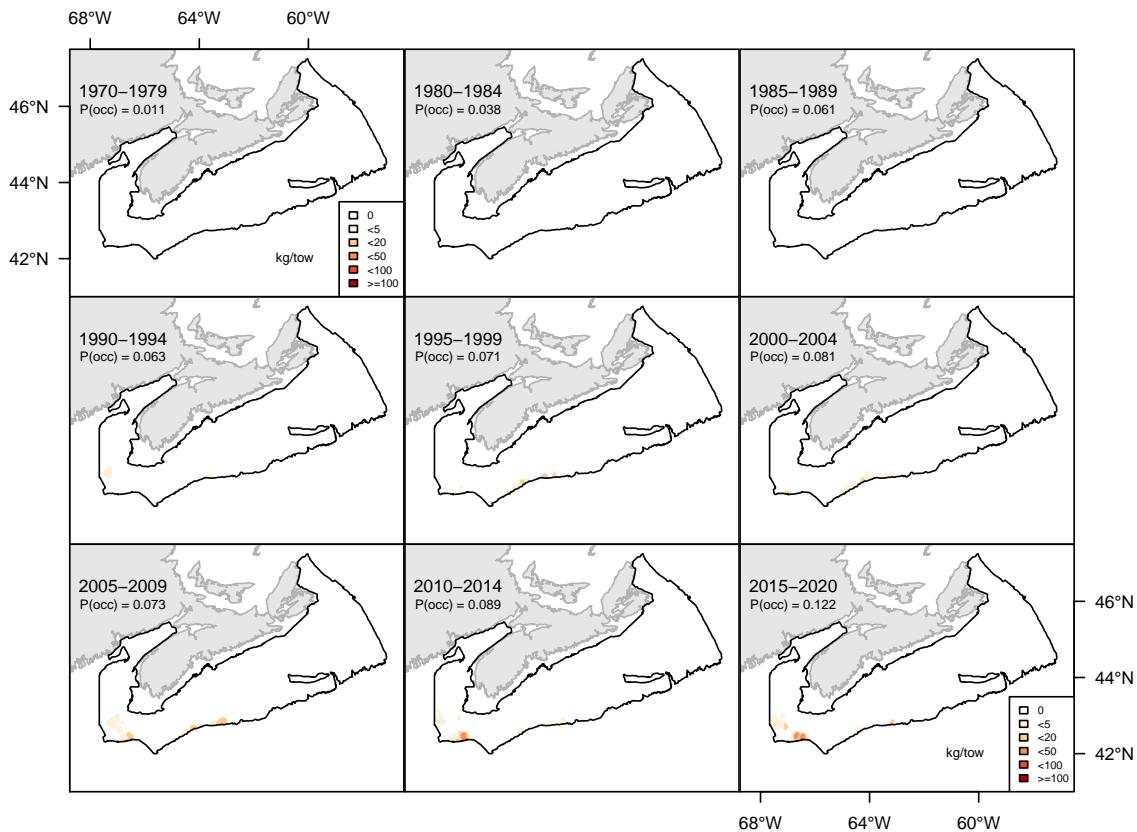


Figure 7.31A. Inverse distance weighted distribution of catch biomass (kg/tow) for Blackbelly rosefish.

975

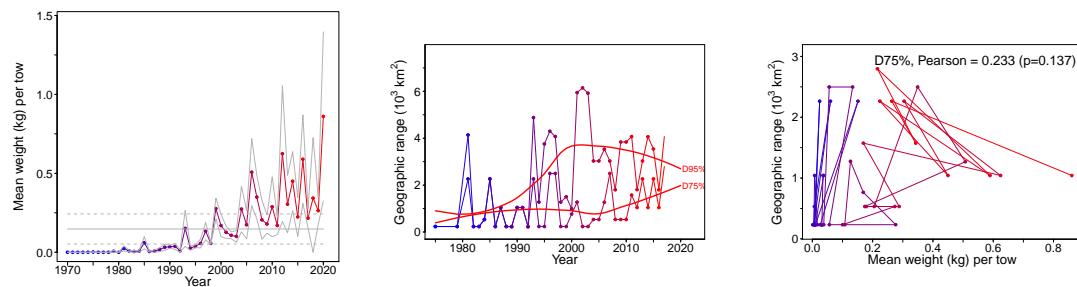


Figure 7.31B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Blackbelly rosefish.

976

7.32 Arctic hookear sculpin (*Hameçon neigeux*) - species code 306 (category LI)

977

Scientific name: [Artediellus uncinatus](#)

978

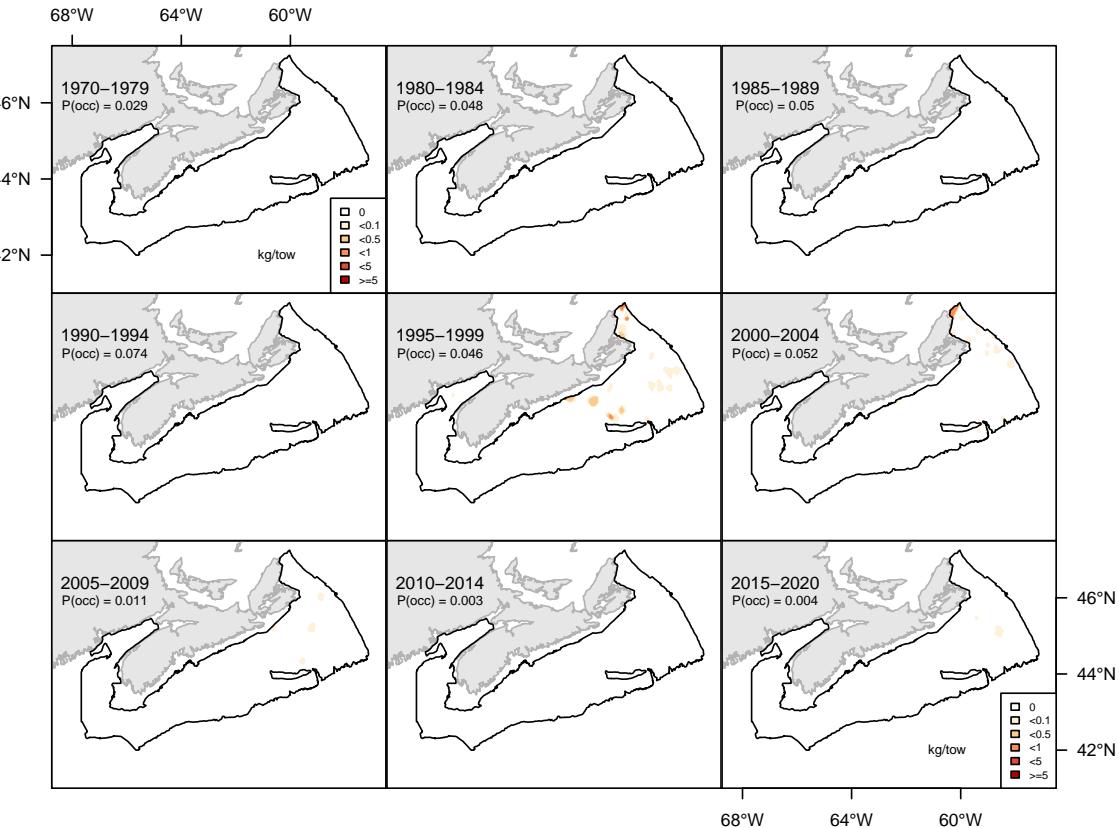


Figure 7.32A. Inverse distance weighted distribution of catch biomass (kg/tow) for Arctic hookear sculpin.

979

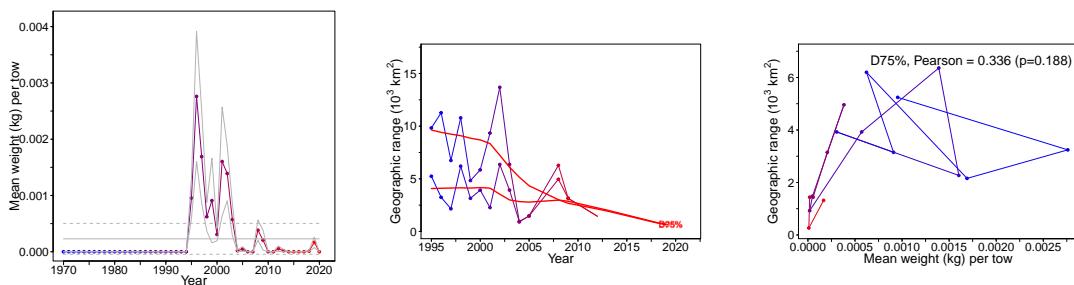


Figure 7.32B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic hookear sculpin.

980 **7.33 Atlantic poacher (*Agone atlantique*) - species code 350 (category LI)**

981 Scientific name: [Leptagonus decagonus](#)

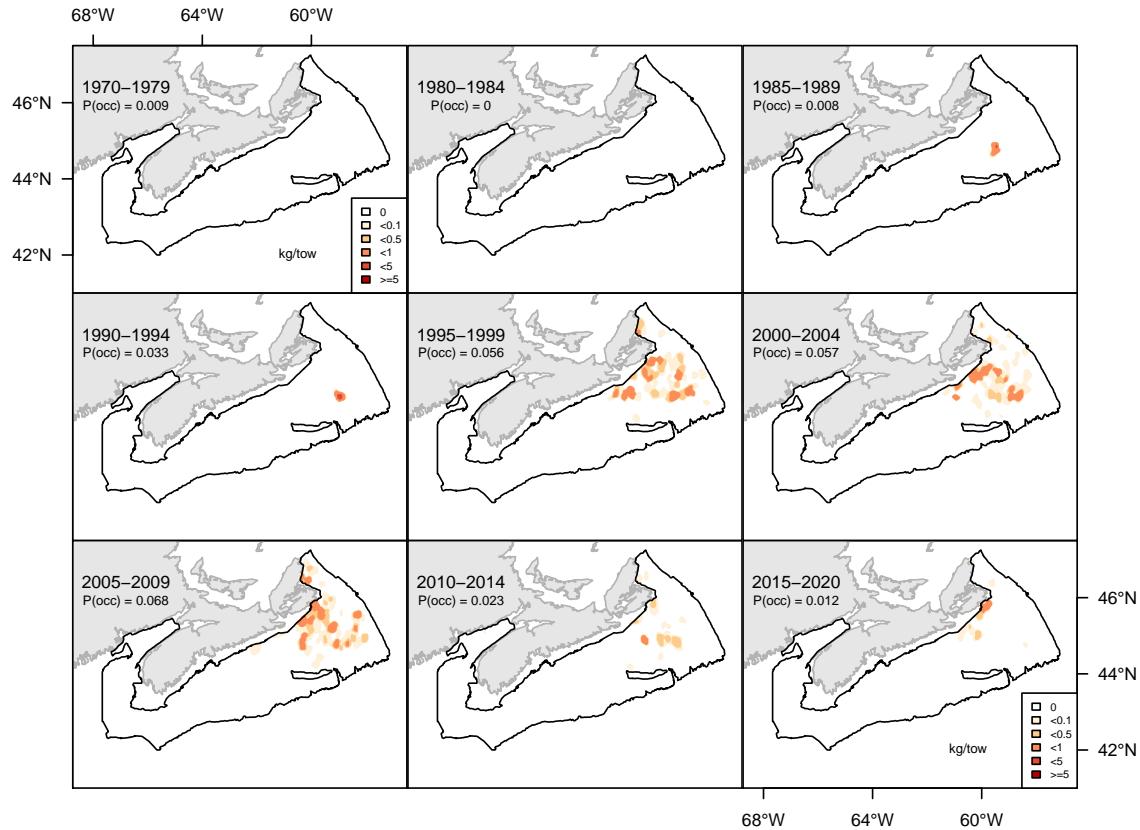


Figure 7.33A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic poacher.

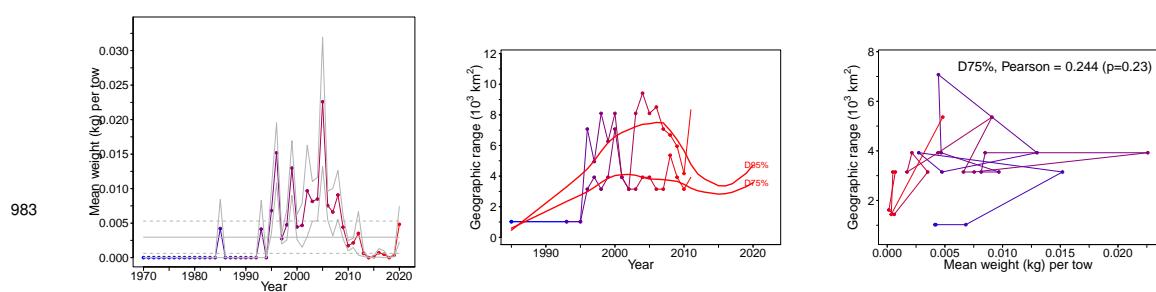


Figure 7.33B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic poacher.

984

7.34 Lumpfish (Lompe) - species code 501 (category LI)

985

Scientific name: [Cyclopterus lumpus](#)

986

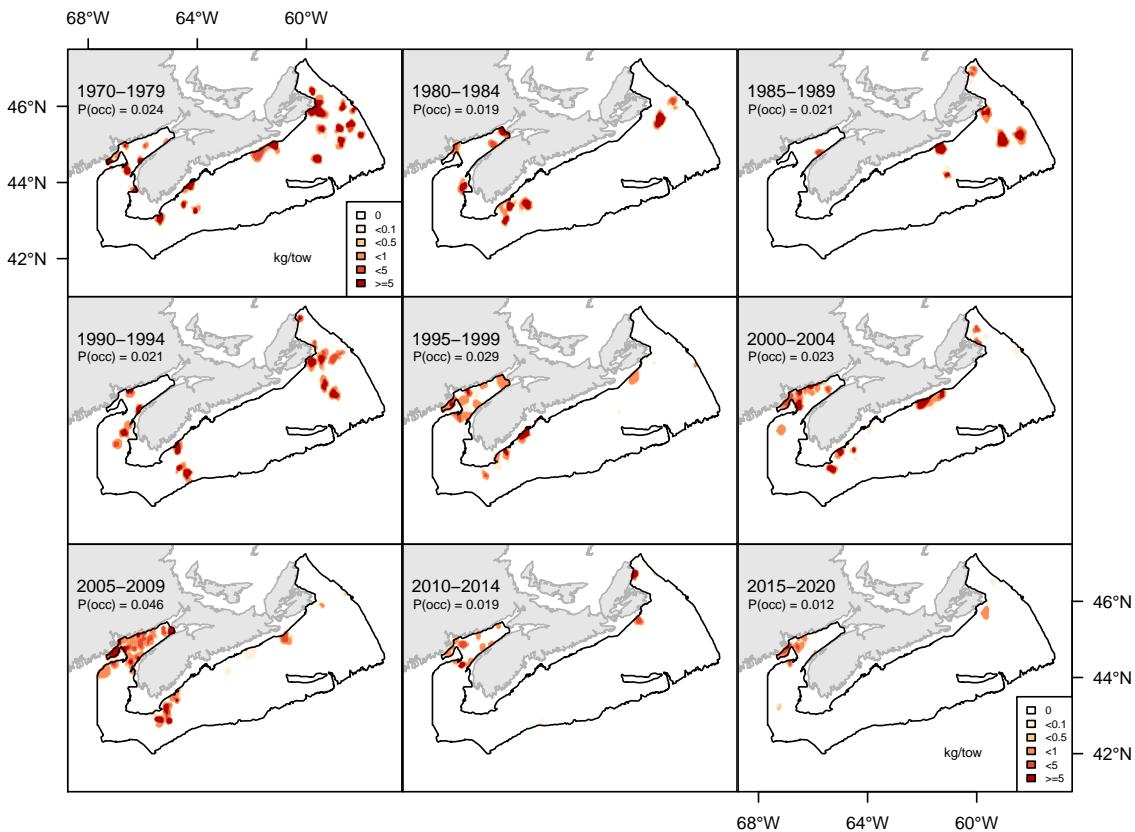


Figure 7.34A. Inverse distance weighted distribution of catch biomass (kg/tow) for Lumpfish.

987

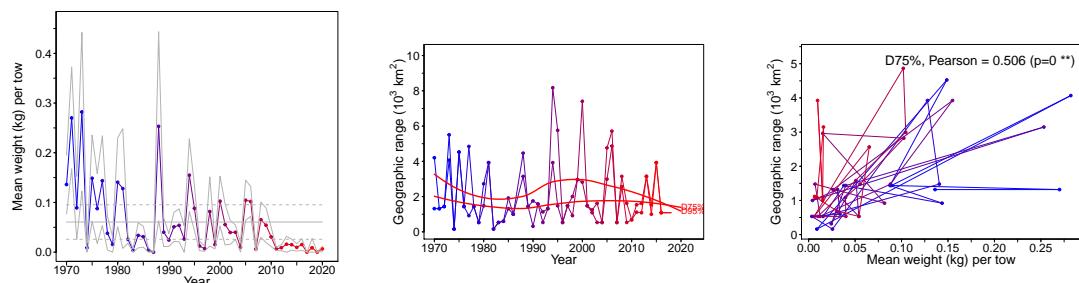


Figure 7.34B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Lumpfish.

988 **7.35 Atlantic spiny lumpsucker (Petite poule de mer atlantique) - species code 502**
 989 (**category LI**)

990 Scientific name: [Eumicrotremus spinosus](#)

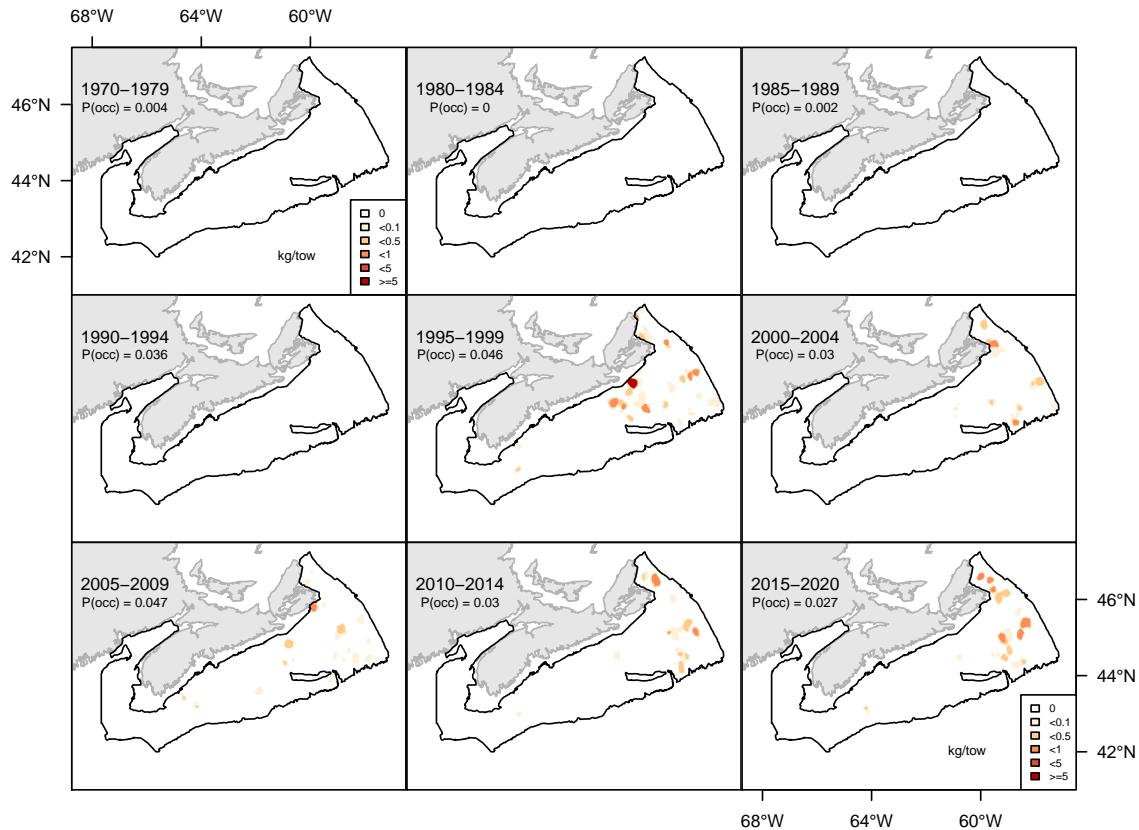


Figure 7.35A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic spiny lumpsucker.

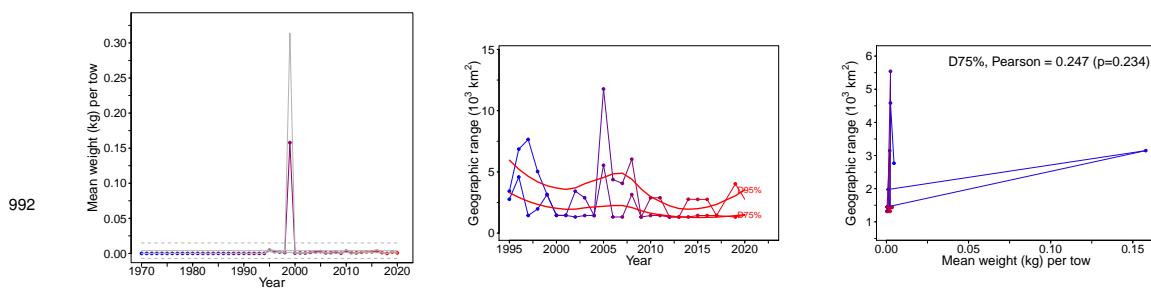


Figure 7.35B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic spiny lumpsucker.

993 **7.36 Atlantic hookear sculpin (Hameçon atlantique) - species code 880 (category LI)**

994 Scientific name: [Artediellus atlanticus](#)

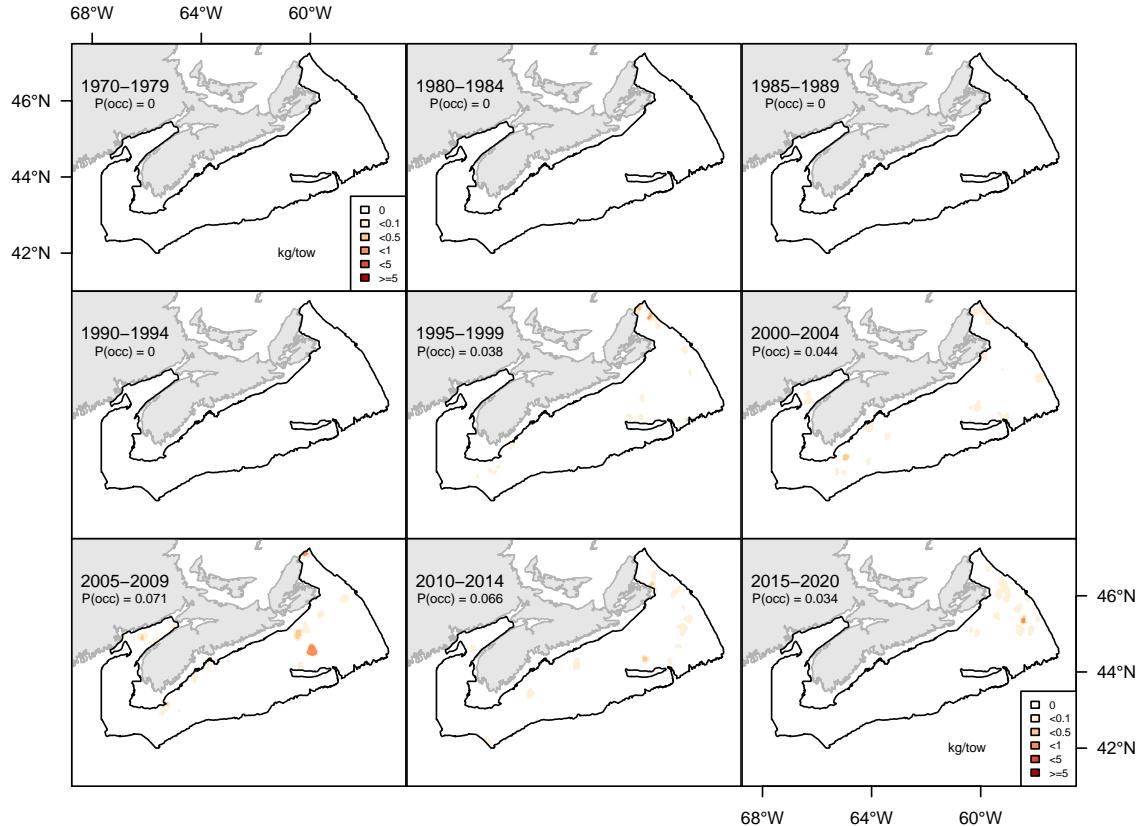


Figure 7.36A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic hookear sculpin.

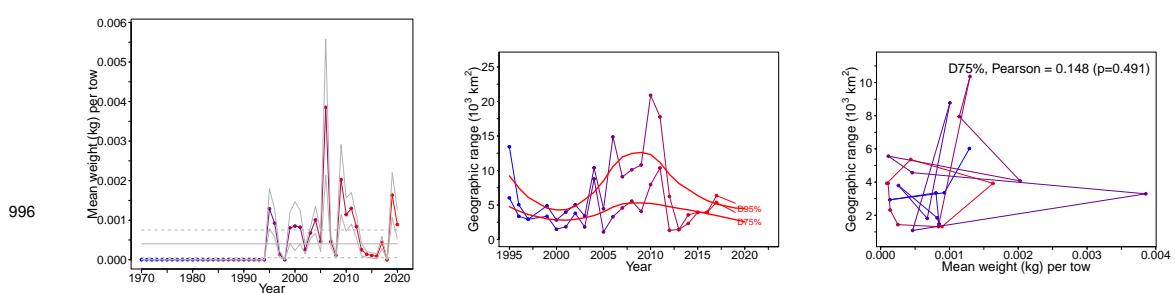


Figure 7.36B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hookear sculpin.

997

7.37 Greenland halibut (Flétan noir) - species code 31 (category LI)

998

Scientific name: [Reinhardtius hippoglossoides](#)

999

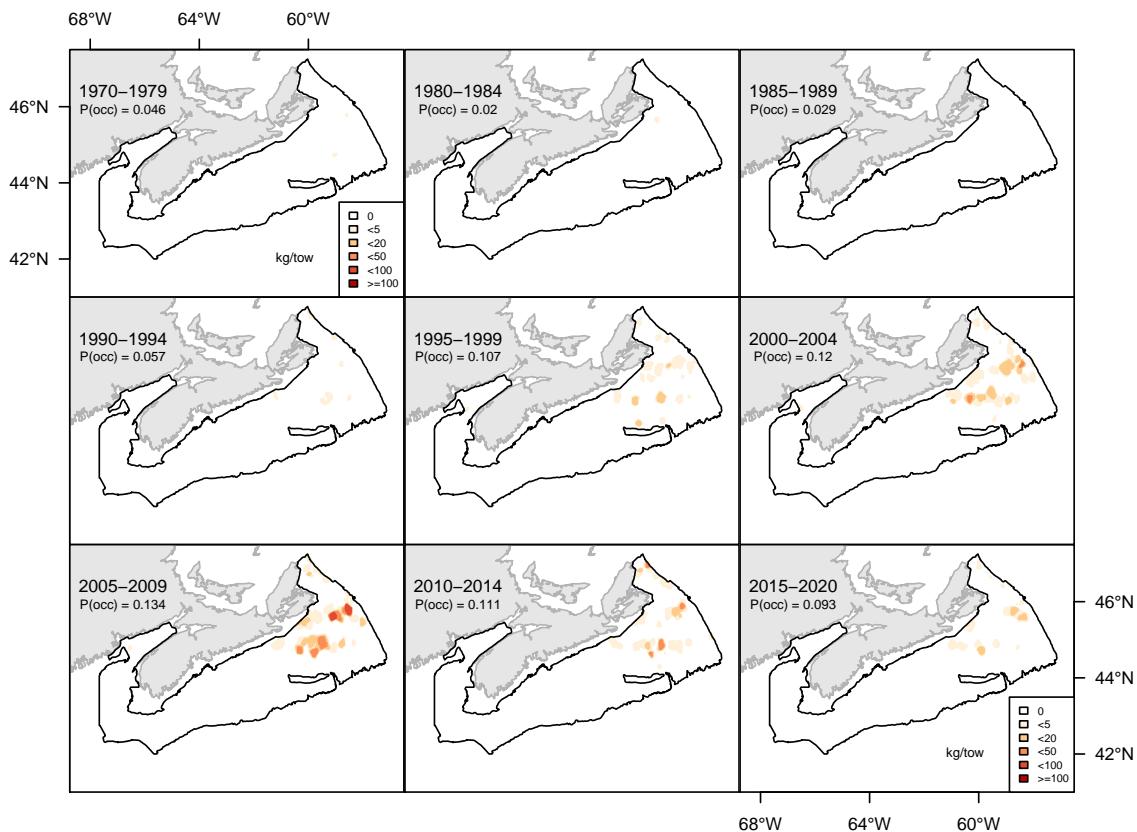


Figure 7.37A. Inverse distance weighted distribution of catch biomass (kg/tow) for Greenland halibut.

1000

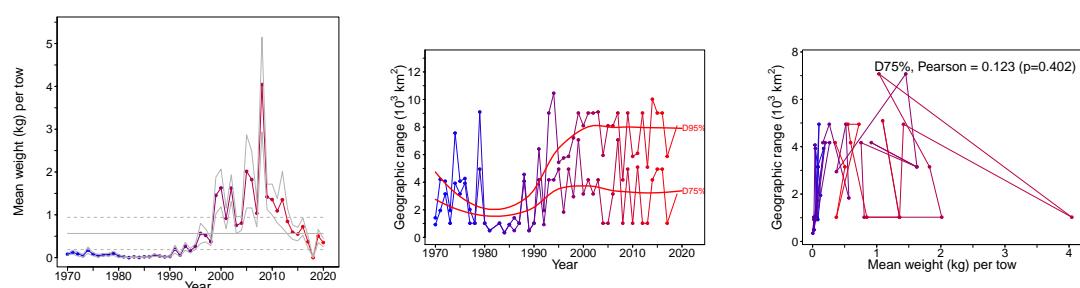


Figure 7.37B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greenland halibut.

1001 **7.38 Gulf Stream flounder (Plie du Gulf Stream) - species code 44 (category LI)**

1002 Scientific name: [Citharichthys arctifrons](#)

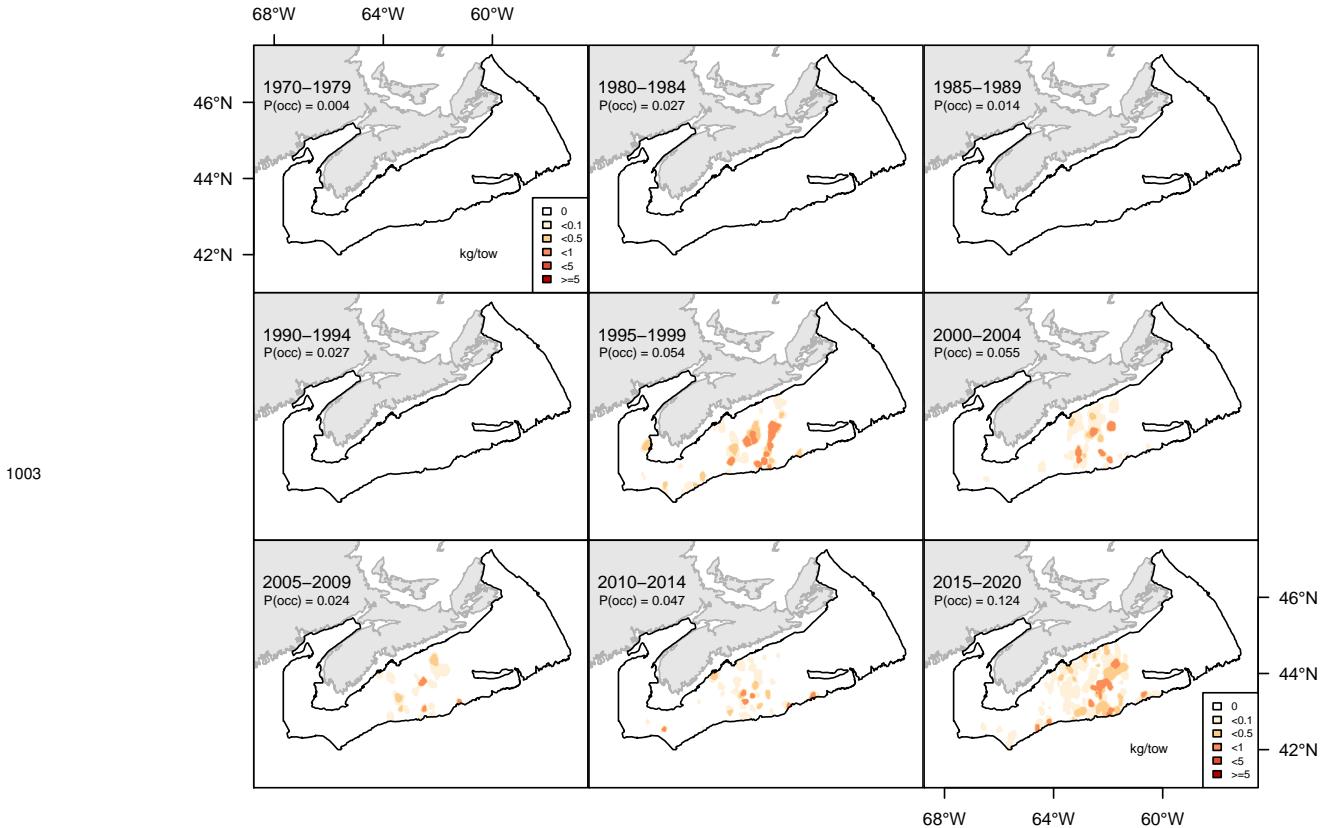


Figure 7.38A. Inverse distance weighted distribution of catch biomass (kg/tow) for Gulf Stream flounder.

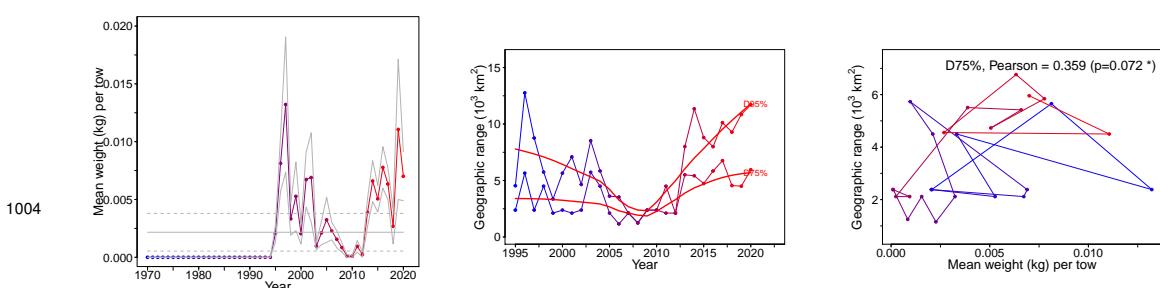


Figure 7.38B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Gulf Stream flounder.

1005 **7.39 Atlantic mackerel (*Maquereau commun*) - species code 70 (category LI)**

1006 Scientific name: [Scomber scombrus](#)

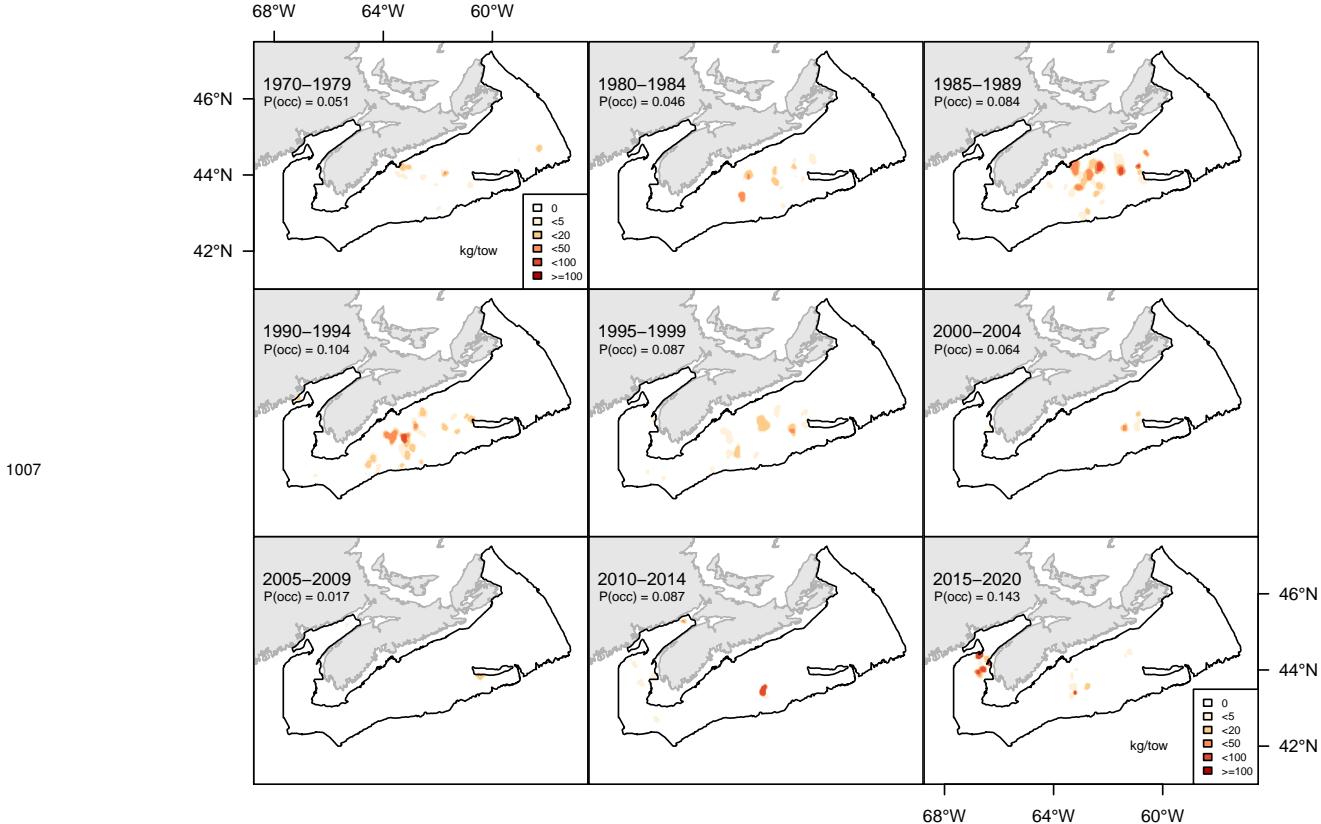


Figure 7.39A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic mackerel.

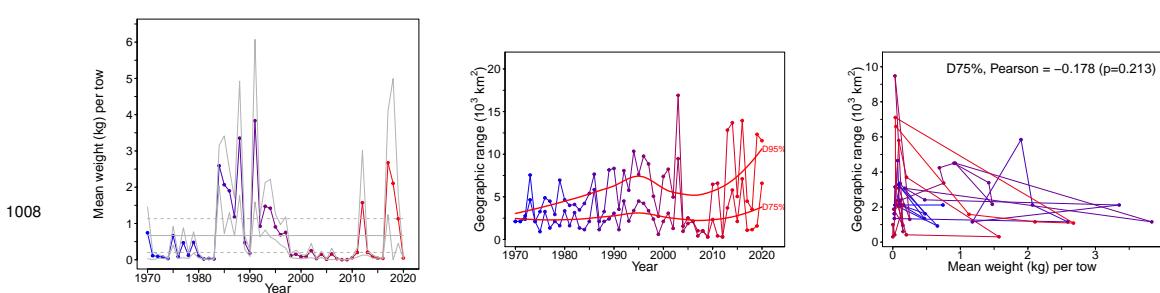


Figure 7.39B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic mackerel.

1009 **7.40 Sand lance (Lançon) - species code 610 (category LI)**

1010 Scientific name: *Ammodytes dubius*

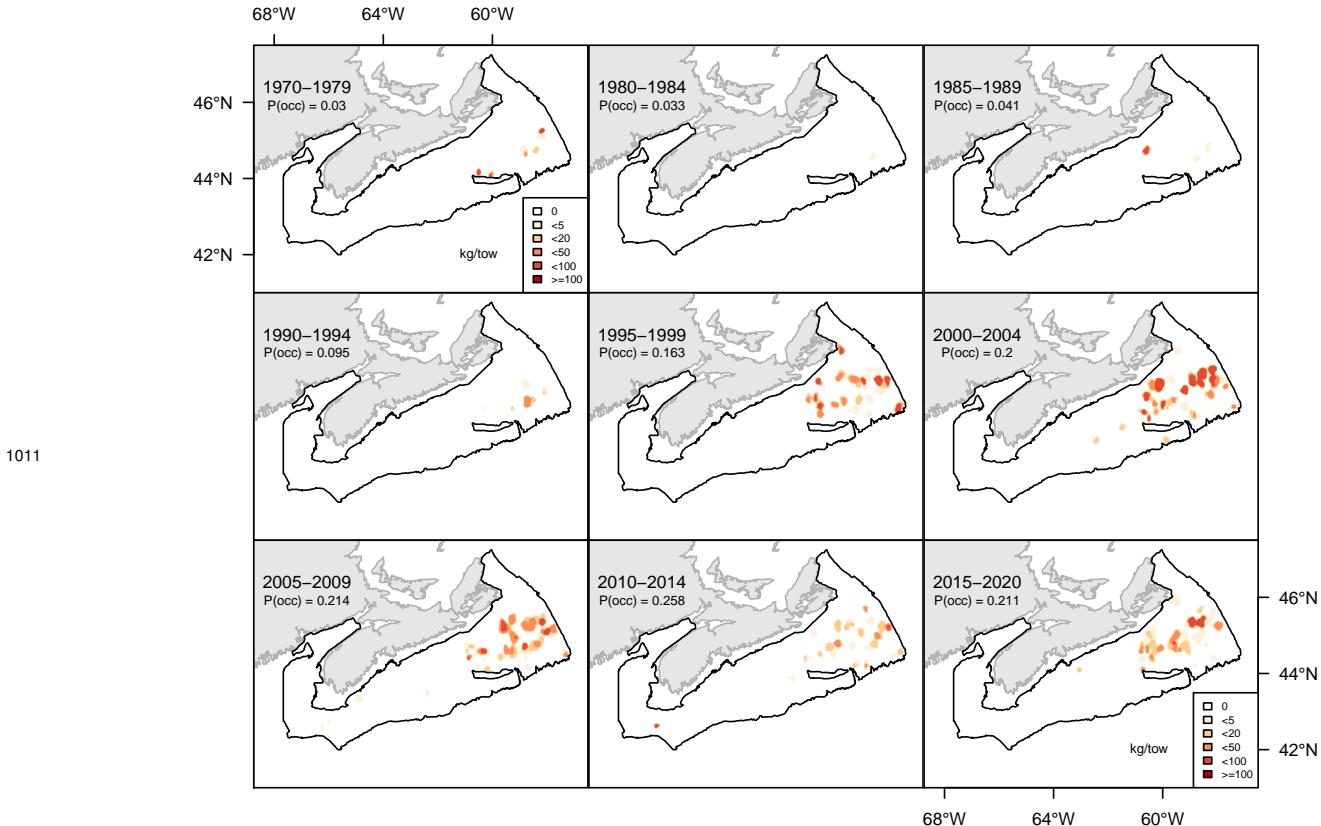


Figure 7.40A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sand lance.

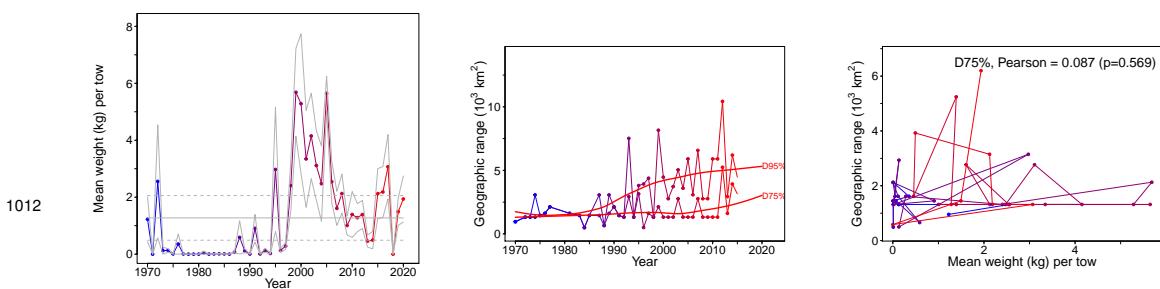


Figure 7.40B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sand lance.

1013

7.41 Snakeblenny (Lompénie-serpent) - species code 622 (category LI)

1014

Scientific name: [Lumpenus lampretaeformis](#)

1015

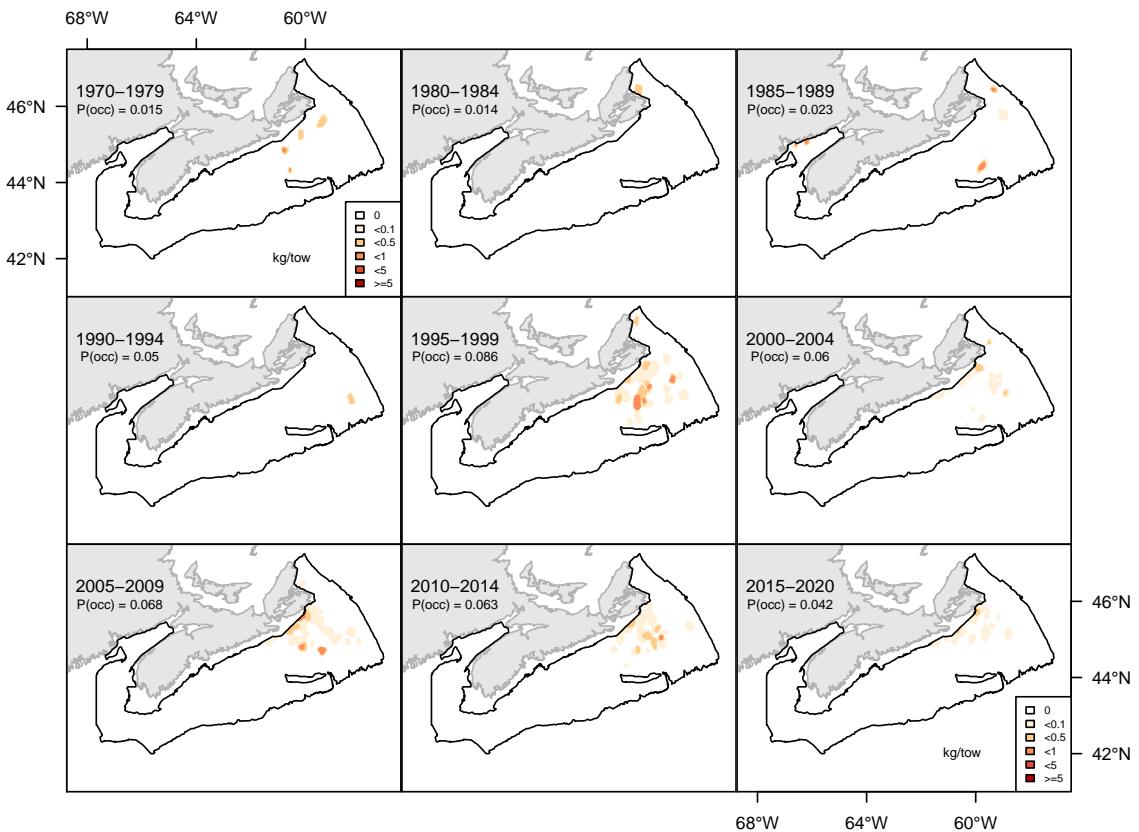


Figure 7.41A. Inverse distance weighted distribution of catch biomass (kg/tow) for Snakeblenny.

1016

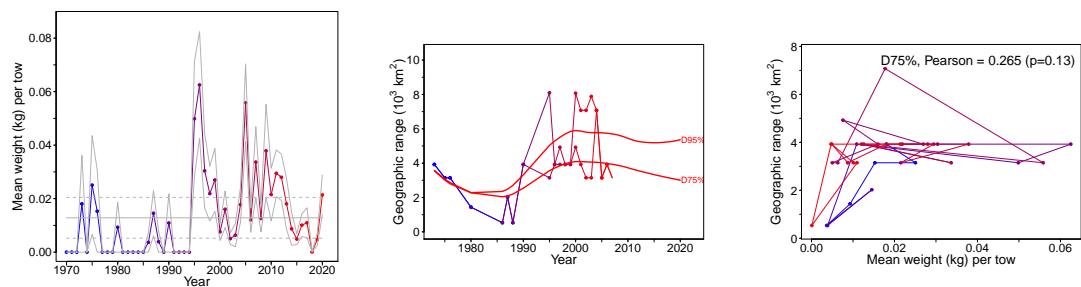


Figure 7.41B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Snakeblenny.

1017

7.42 Daubed shanny (Lompénie tachetée) - species code 623 (category LI)

1018

Scientific name: [Leptoclinus maculatus](#)

1019

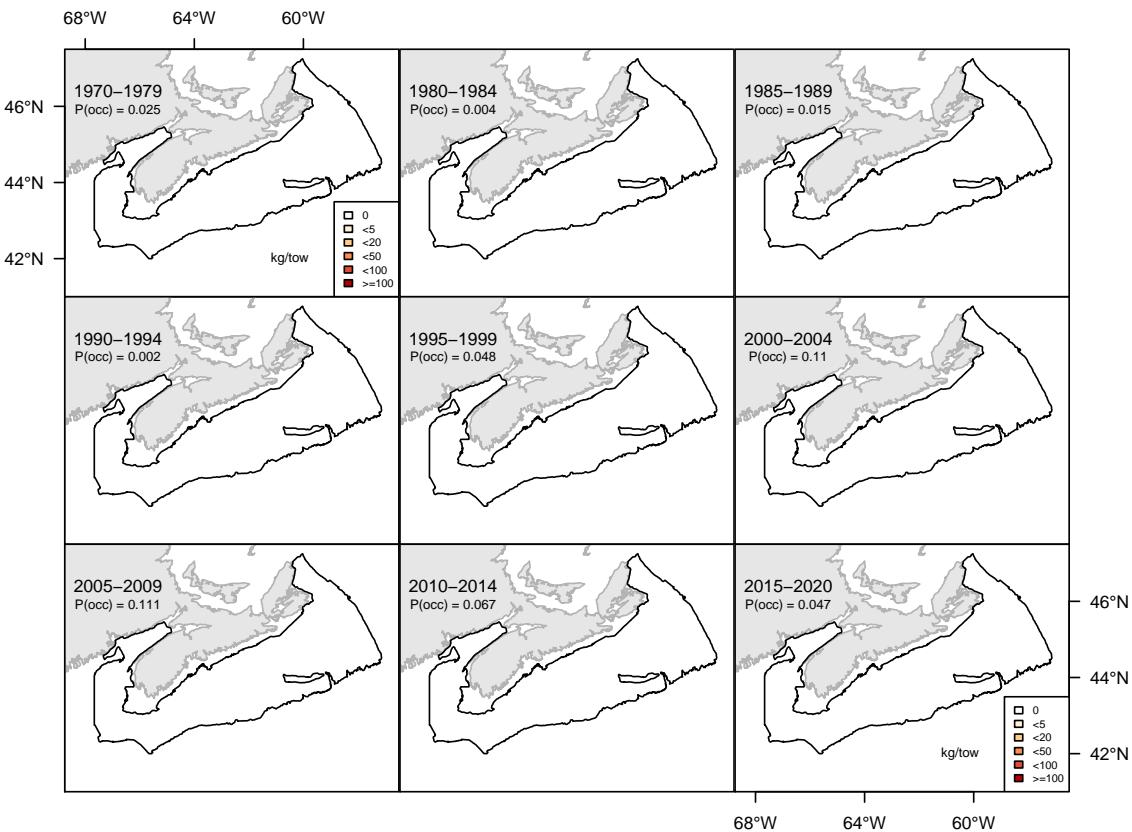


Figure 7.42A. Inverse distance weighted distribution of catch biomass (kg/tow) for Daubed shanny.

1020

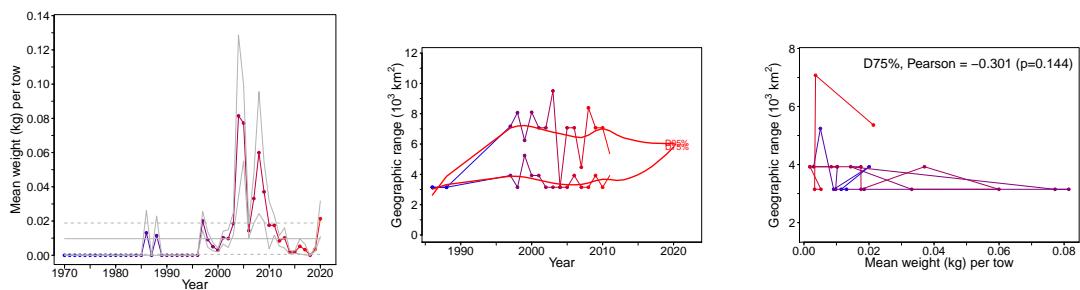


Figure 7.42B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Daubed shanny.

1021

7.43 Vahl's eelpout (*Lycodes vahlii*) - species code 647 (category LI)

1022

Scientific name: [Lycodes vahlii](#)

1023

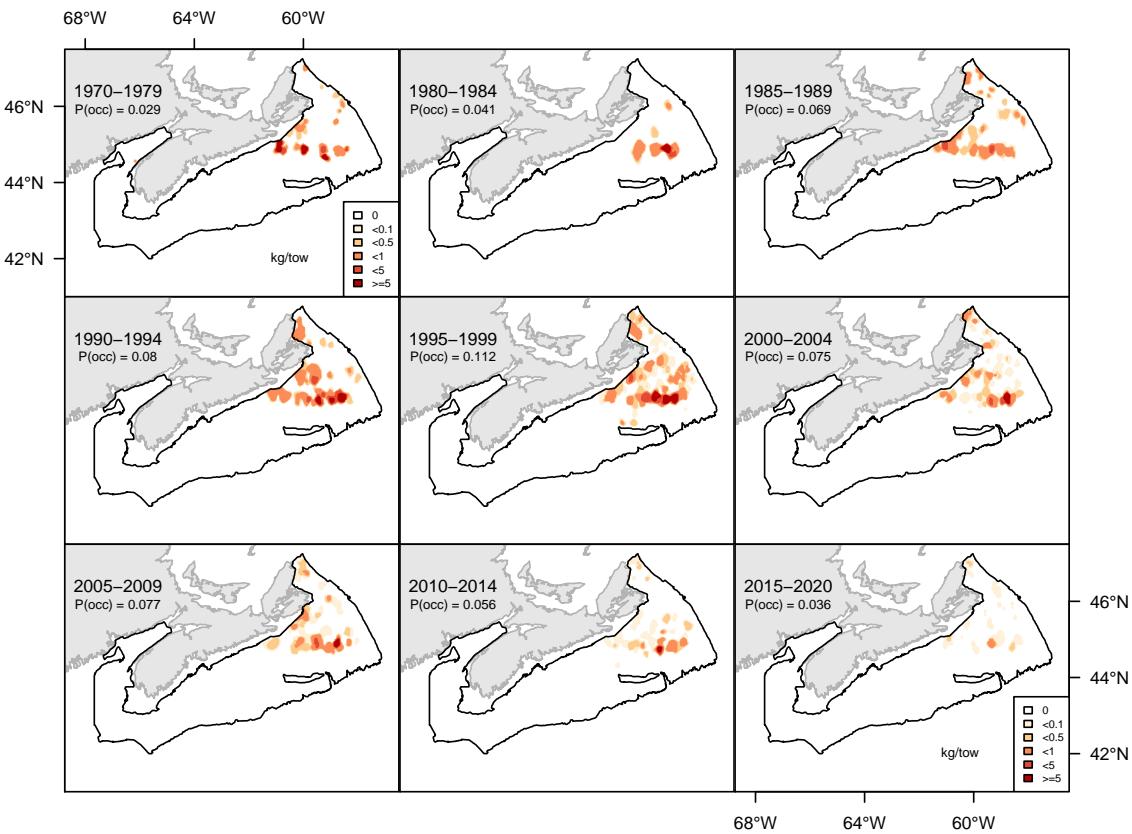


Figure 7.43A. Inverse distance weighted distribution of catch biomass (kg/tow) for Vahl's eelpout.

1024

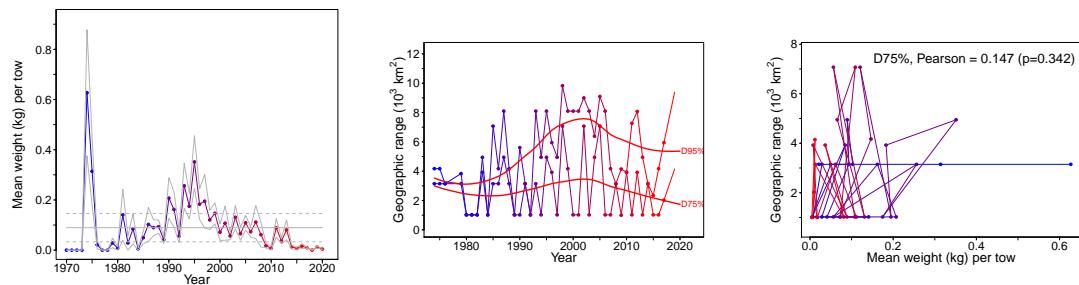


Figure 7.43B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Vahl's eelpout.

1025

7.44 Atlantic butterfish (*Stromaté fossette*) - species code 701 (category LI)

1026

Scientific name: [Peprilus triacanthus](#)

1027

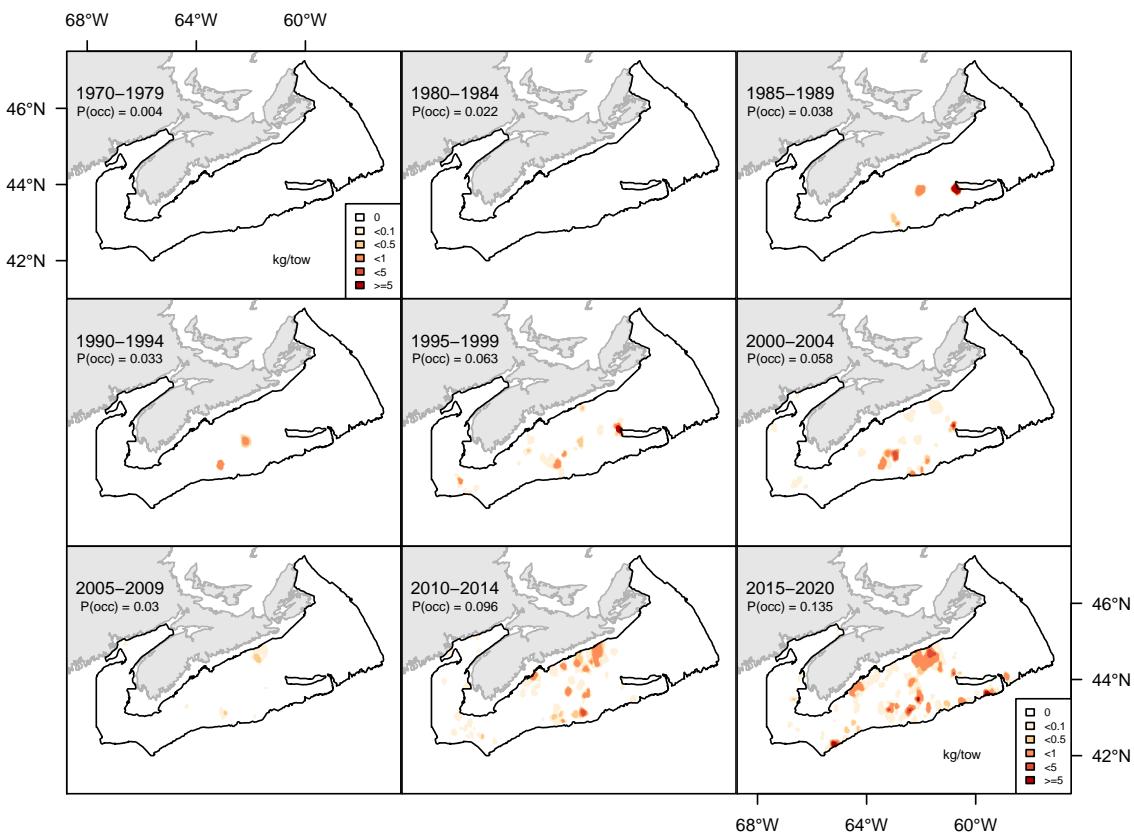


Figure 7.44A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic butterfish.

1028

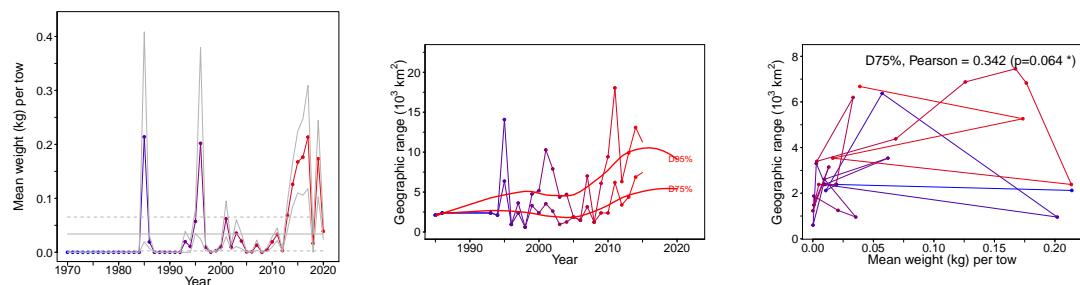


Figure 7.44B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic butterfish.

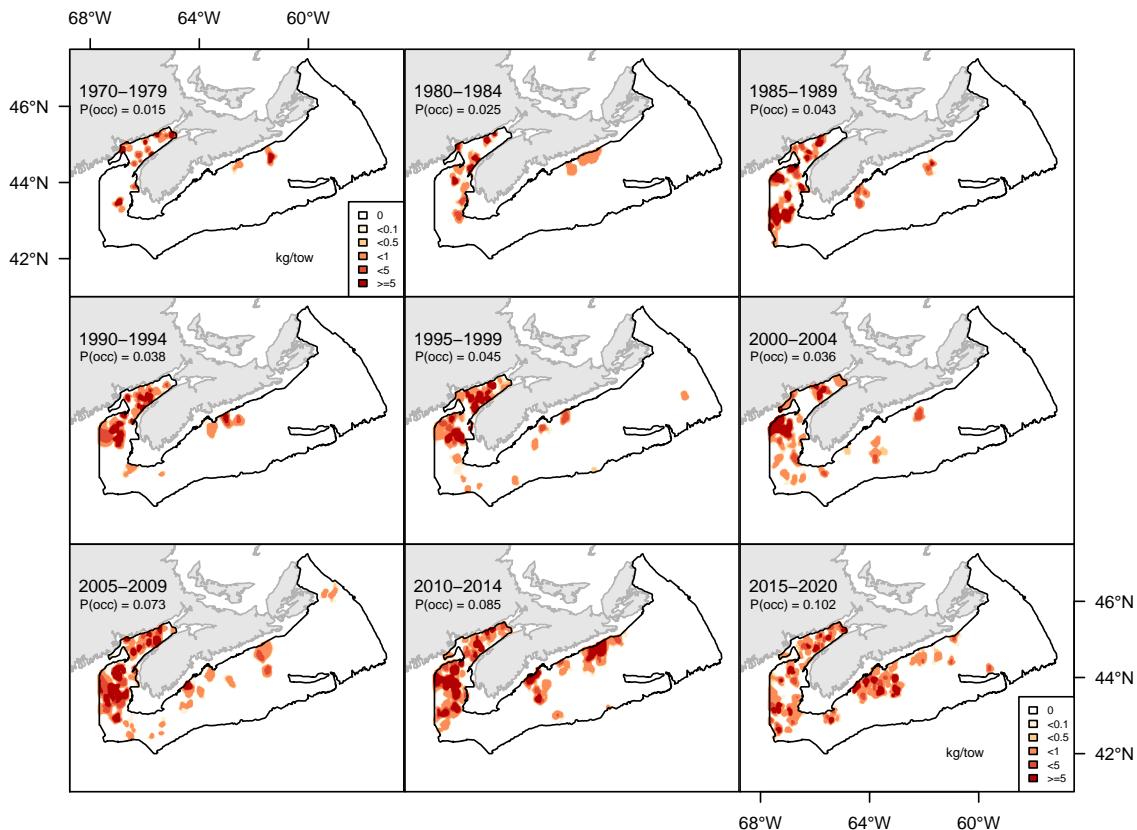
1029

7.45 American shad (*Alose savoureuse*) - species code 61 (category LI)

1030

Scientific name: [Alosa sapidissima](#)

1031



1032

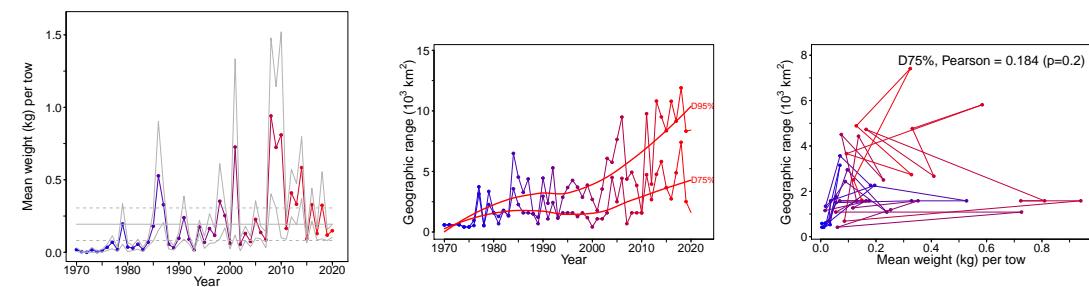


Figure 7.45B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American shad.

1033

7.46 Alewife (Gaspareau) - species code 62 (category LI)

1034

Scientific name: *Alosa pseudoharengus*

1035

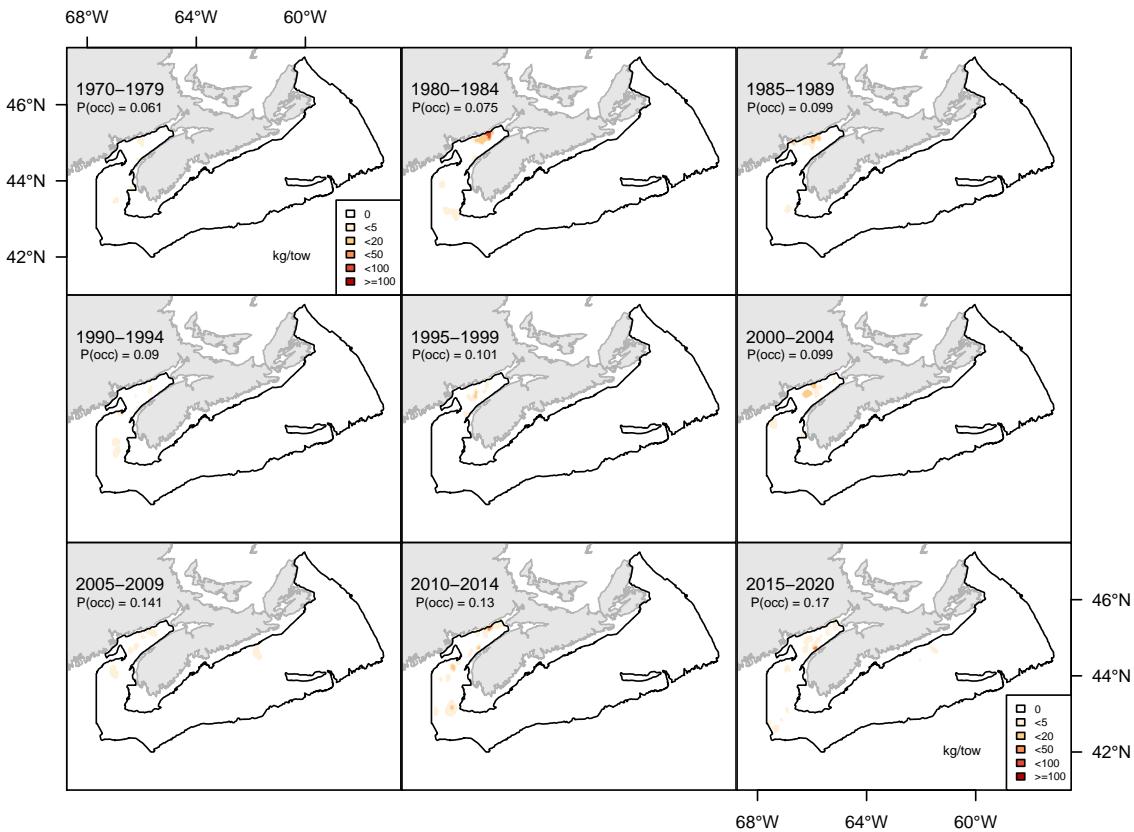


Figure 7.46A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alewife.

1036

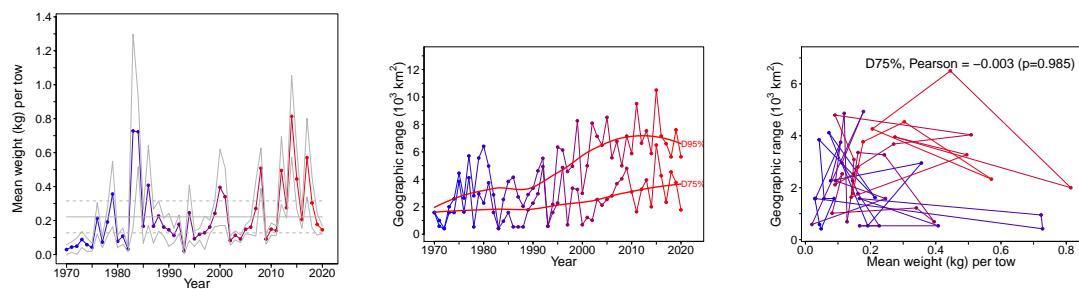


Figure 7.46B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alewife.

1037

7.47 Capelin (Capelan) - species code 64 (category LI)

1038

Scientific name: [Mallotus villosus](#)

1039

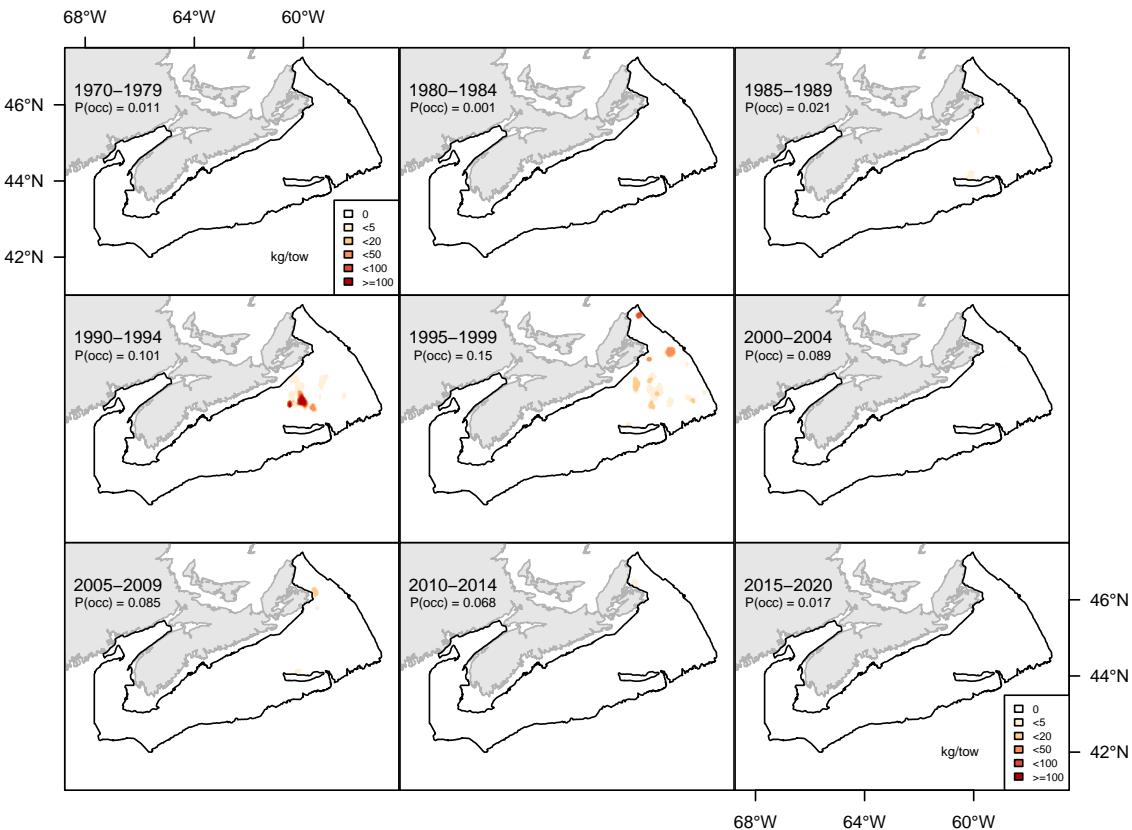


Figure 7.47A. Inverse distance weighted distribution of catch biomass (kg/tow) for Capelin.

1040

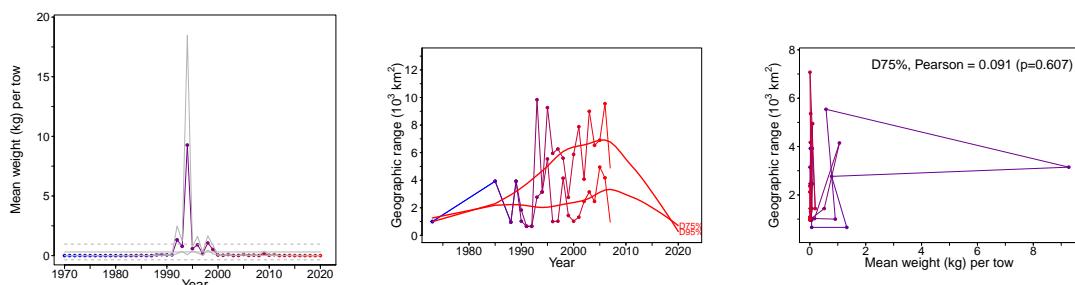


Figure 7.47B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Capelin.

1041

7.48 Greater argentine (Grande argentine) - species code 160 (category LI)

1042

Scientific name: [Argentina silus](#)

1043

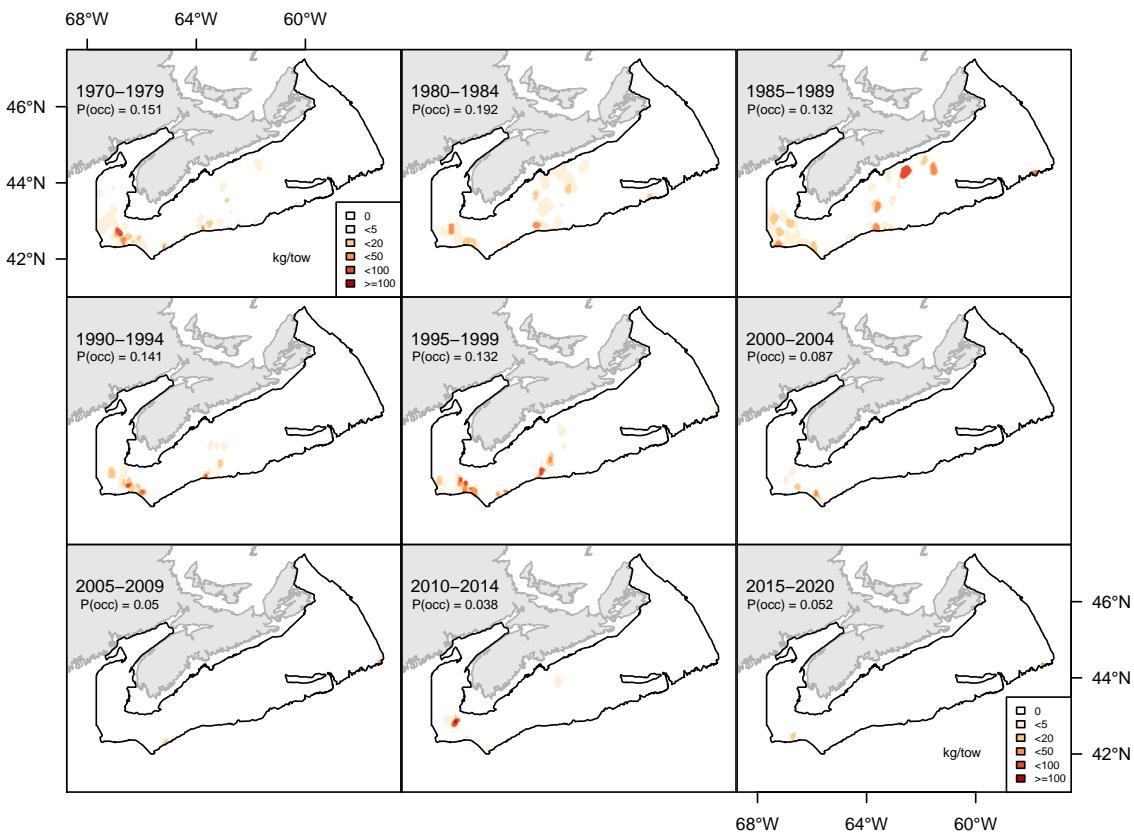


Figure 7.48A. Inverse distance weighted distribution of catch biomass (kg/tow) for Greater argentine.

1044

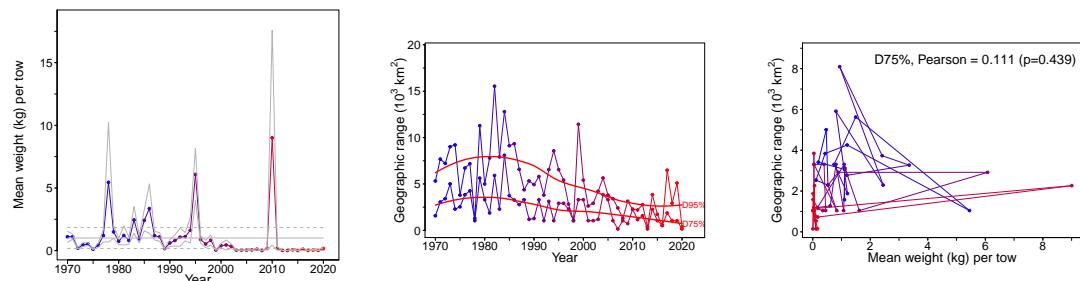


Figure 7.48B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greater argentine.

1045

7.49 Barndoor skate (Grande raie) - species code 200 (category LI)

1046

Scientific name: [Dipturus laevis](#)

1047

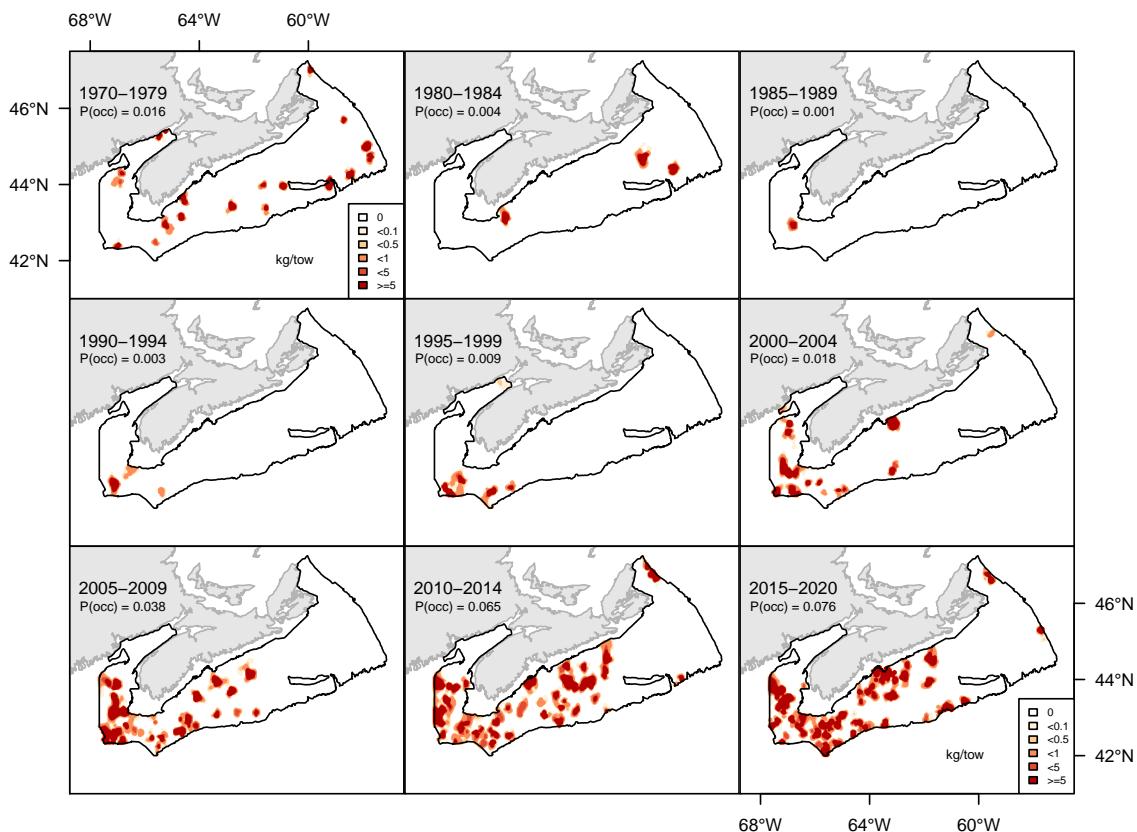


Figure 7.49A. Inverse distance weighted distribution of catch biomass (kg/tow) for Barndoor skate.

1048

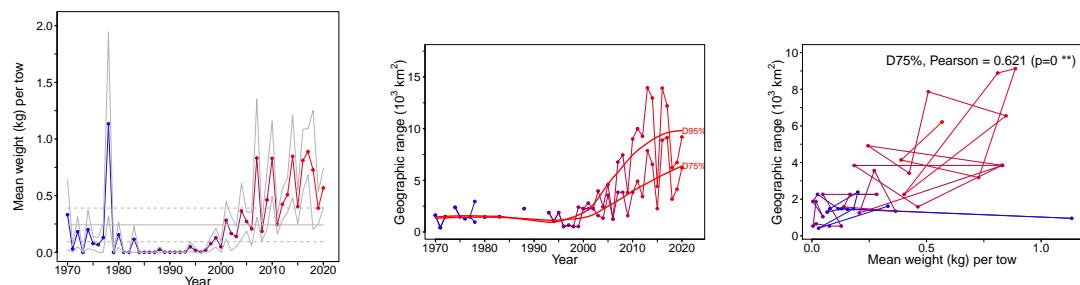


Figure 7.49B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Barndoor skate.

1049

7.50 Little skate (Raie hérisson) - species code 203 (category LI)

1050

Scientific name: [Leucoraja erinacea](#)

1051

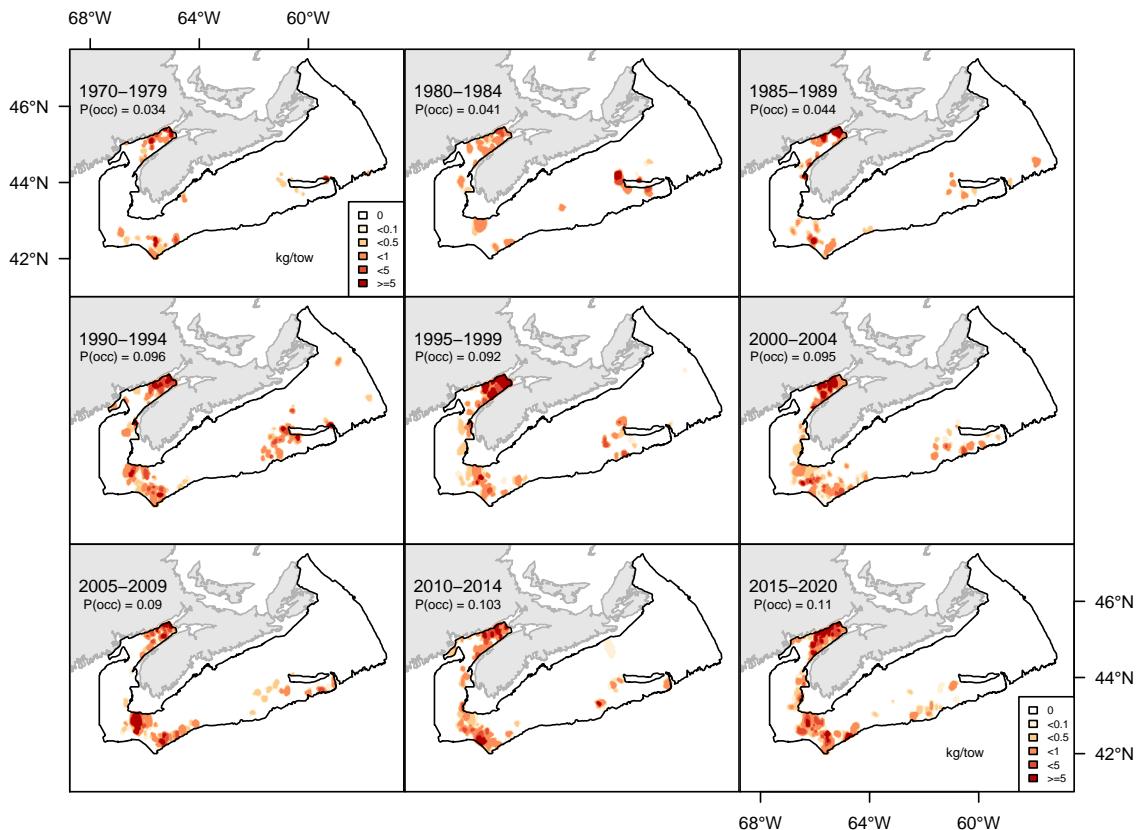


Figure 7.50A. Inverse distance weighted distribution of catch biomass (kg/tow) for Little skate.

1052

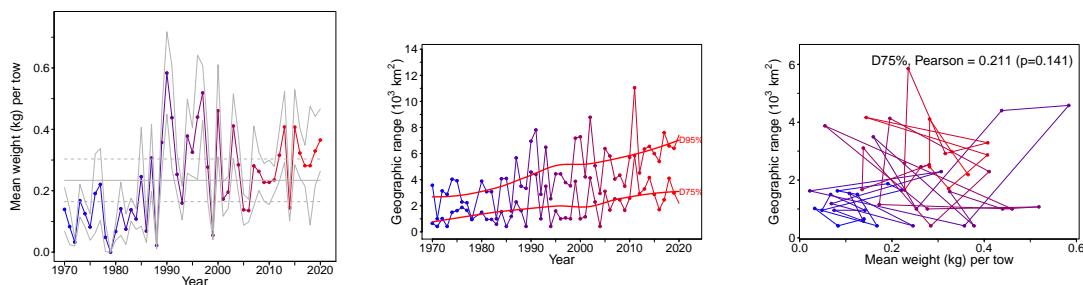


Figure 7.50B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Little skate.

1053

7.51 Northern prawn (Crevette nordique) - species code 2211 (category SF)

1054

Scientific name: [Pandalus borealis](#)

1055

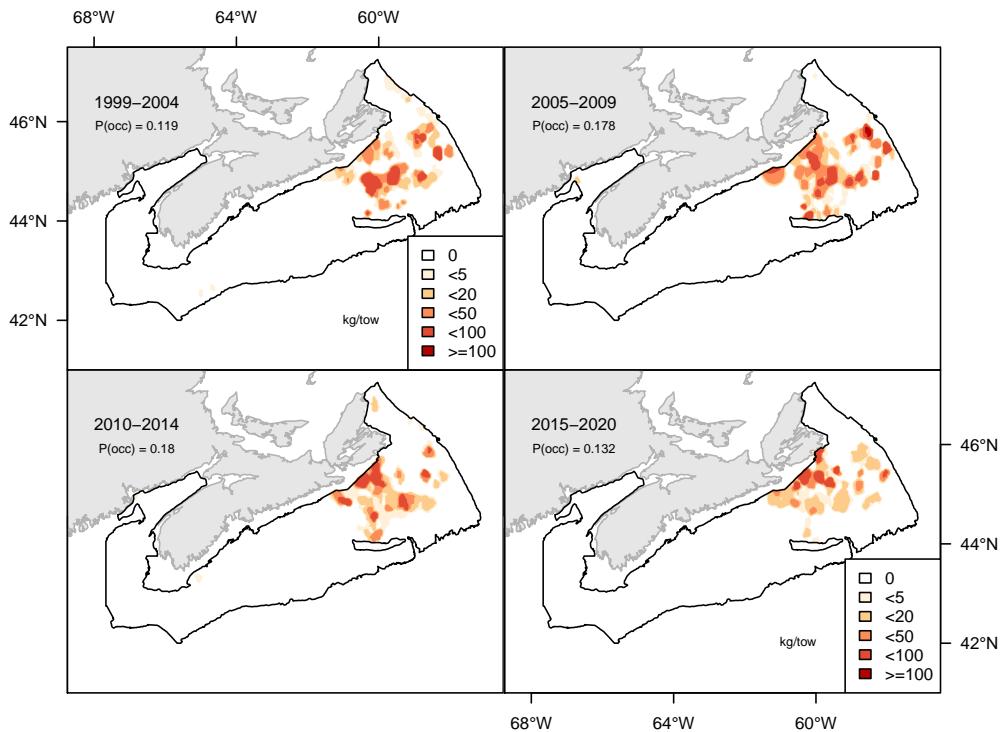


Figure 7.51A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern prawn.

1056

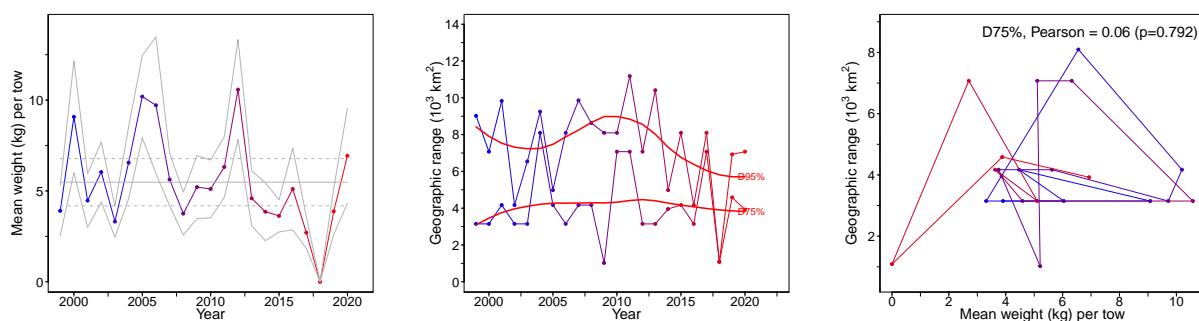


Figure 7.51B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern prawn.

1057

7.52 Jonah crab (*Tourteau jona*) - species code 2511 (category SF)

1058

Scientific name: [Cancer borealis](#)

1059

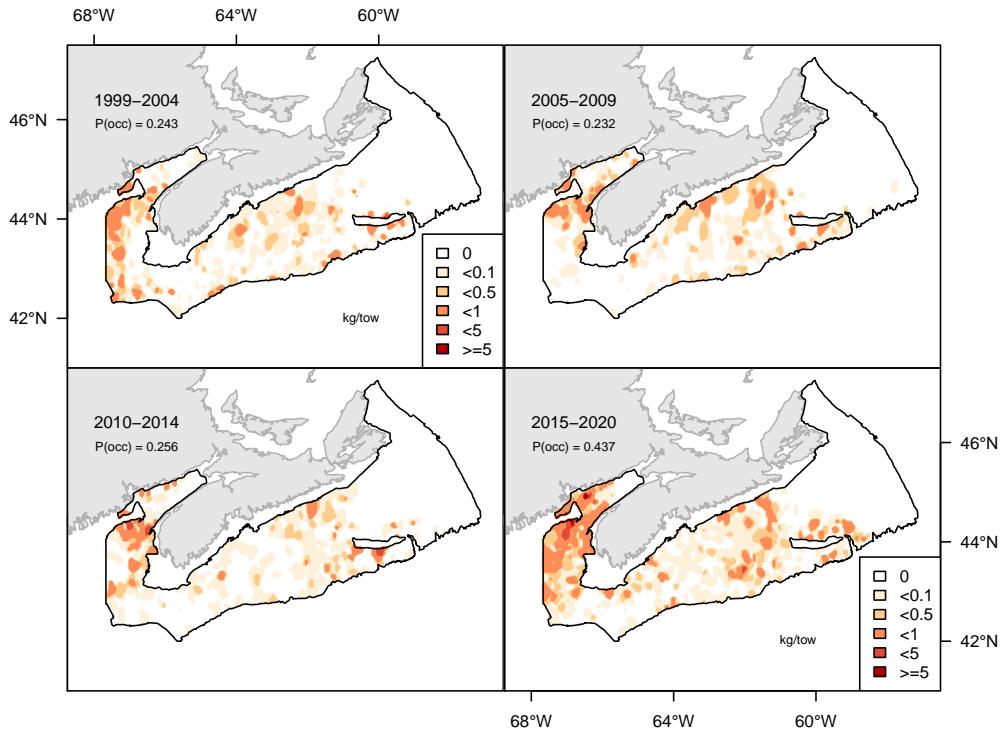


Figure 7.52A. Inverse distance weighted distribution of catch biomass (kg/tow) for Jonah crab.

1060

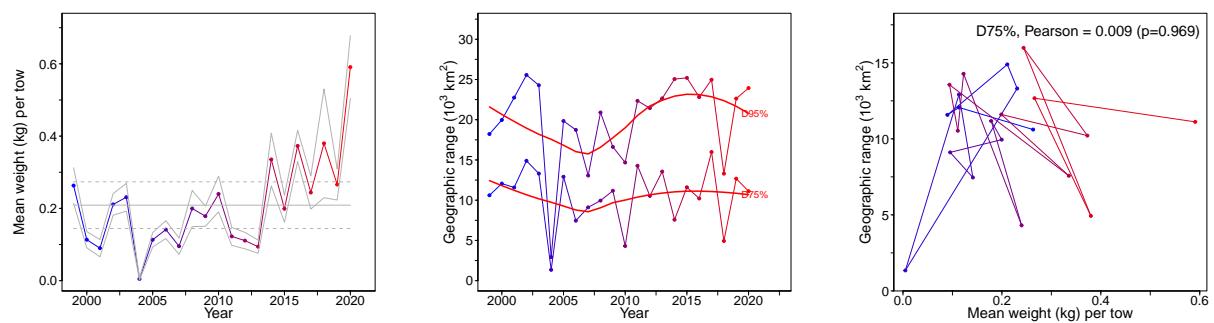


Figure 7.52B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Jonah crab.

1061

7.53 Atlantic rock crab (Tourteau poïnclos) - species code 2513 (category SF)

1062

Scientific name: [Cancer irroratus](#)

1063

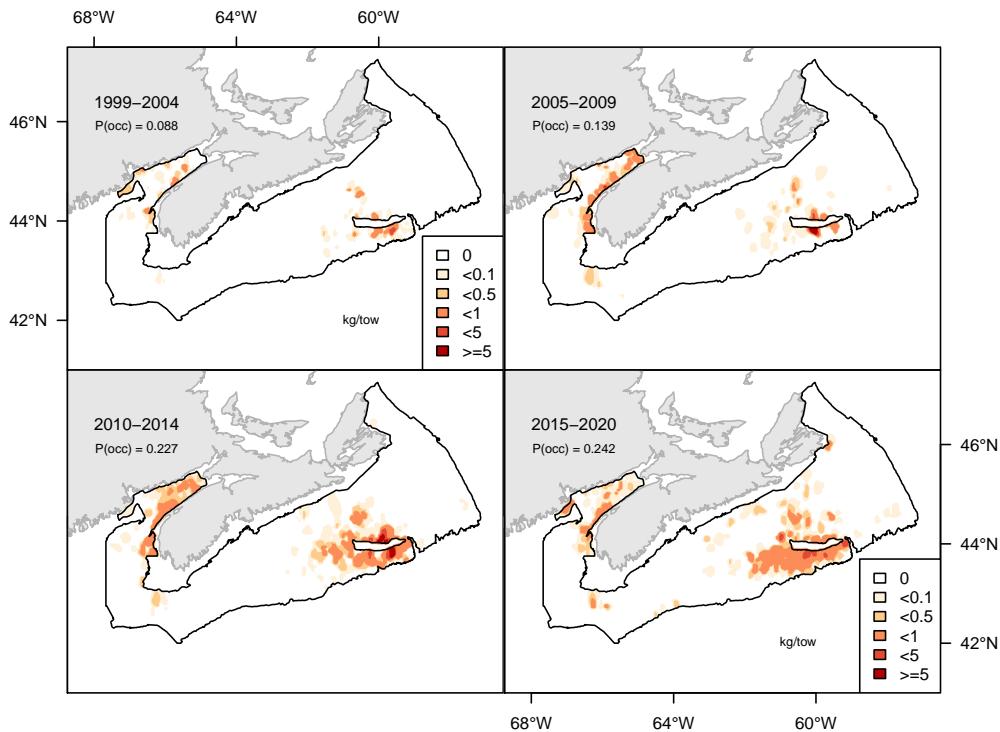


Figure 7.53A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic rock crab.

1064

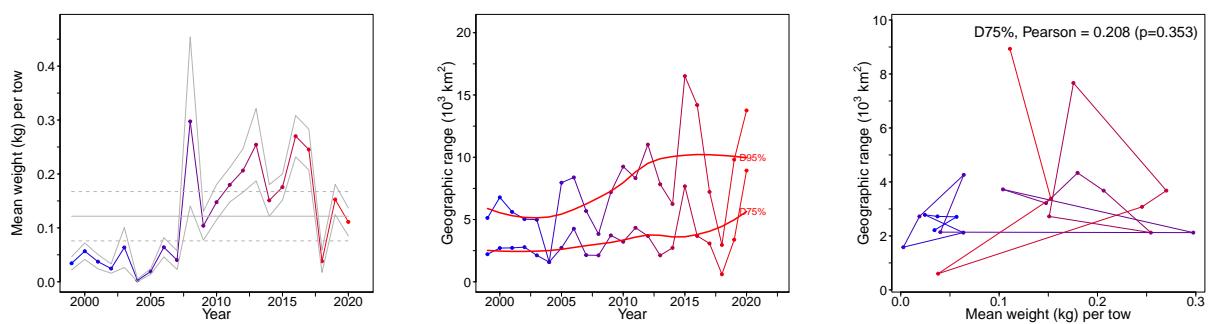


Figure 7.53B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic rock crab.

1065 **7.54 Arctic lyre crab (*Crabe Hyas coarctatus*) - species code 2521 (category SF)**

1066 Scientific name: [Hyas coarctatus](#)

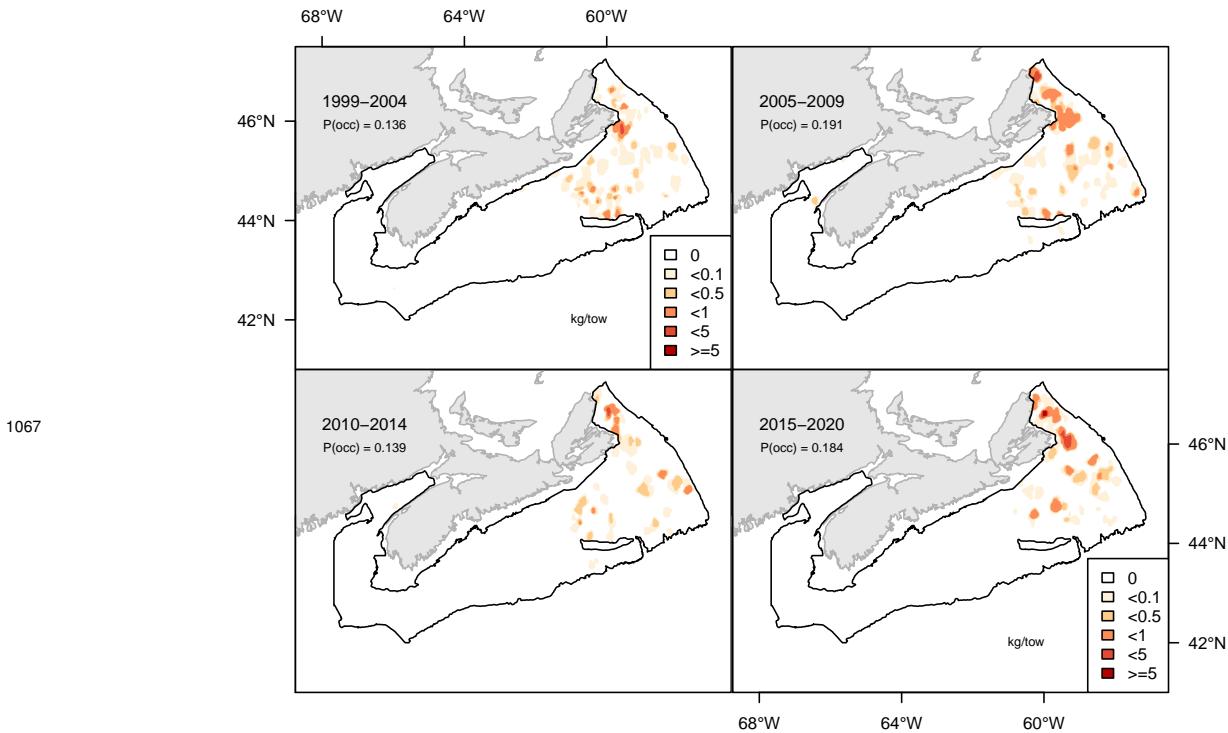


Figure 7.54A. Inverse distance weighted distribution of catch biomass (kg/tow) for Arctic lyre crab.

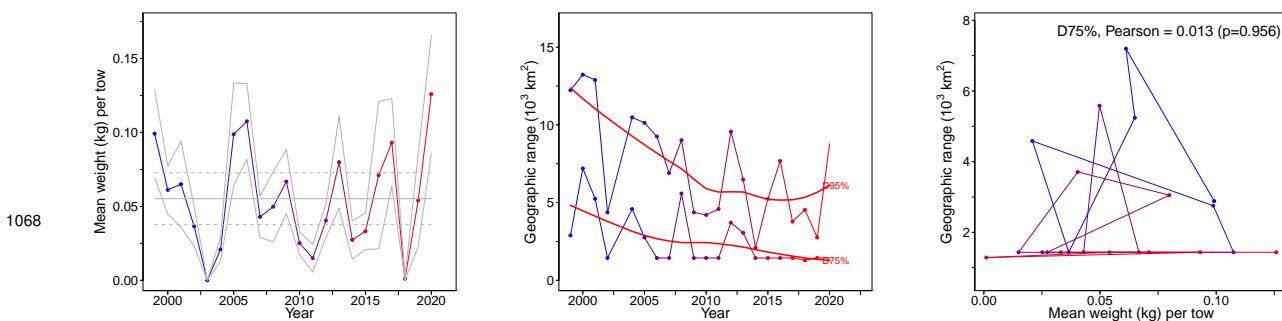


Figure 7.54B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic lyre crab.

1069 **7.55 Atlantic king crab (Crabe épineux du nord) - species code 2523 (category SF)**

1070 Scientific name: [Lithodes maja](#)

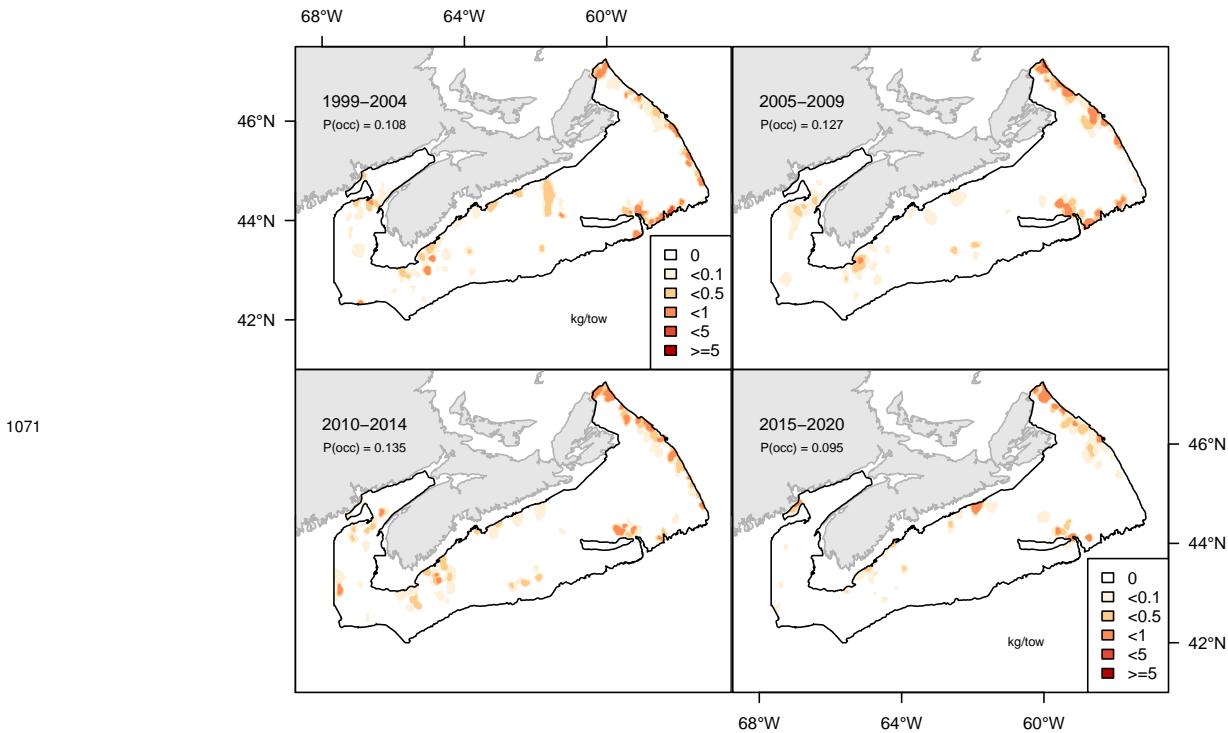


Figure 7.55A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic king crab.

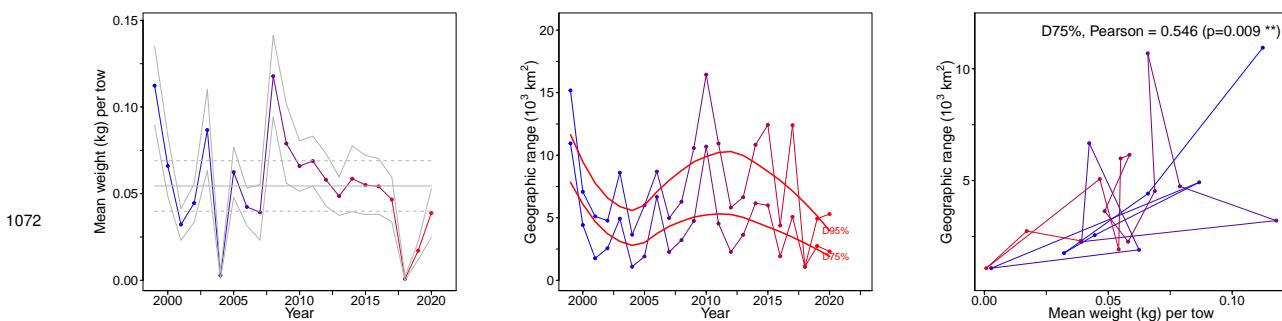


Figure 7.55B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic king crab.

1073

7.56 Queen crab (Crabe des neiges) - species code 2526 (category SF)

1074

Scientific name: [Chionoecetes opilio](#)

1075

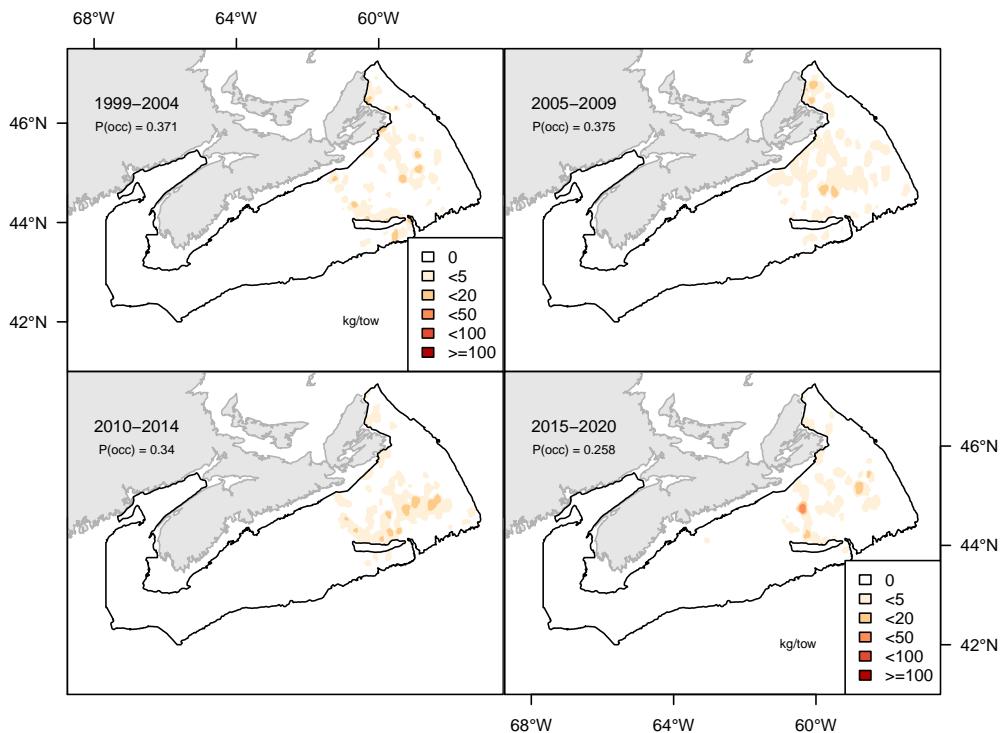


Figure 7.56A. Inverse distance weighted distribution of catch biomass (kg/tow) for Queen crab.

1076

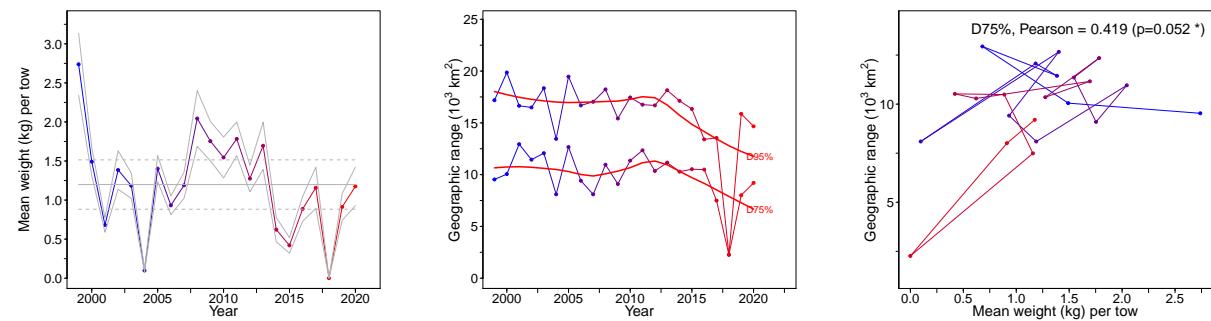


Figure 7.56B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Queen crab.

1077

7.57 Great spider crab (Crabe lyre araignée) - species code 2527 (category SF)

1078

Scientific name: [Hyas araneus](#)

1079

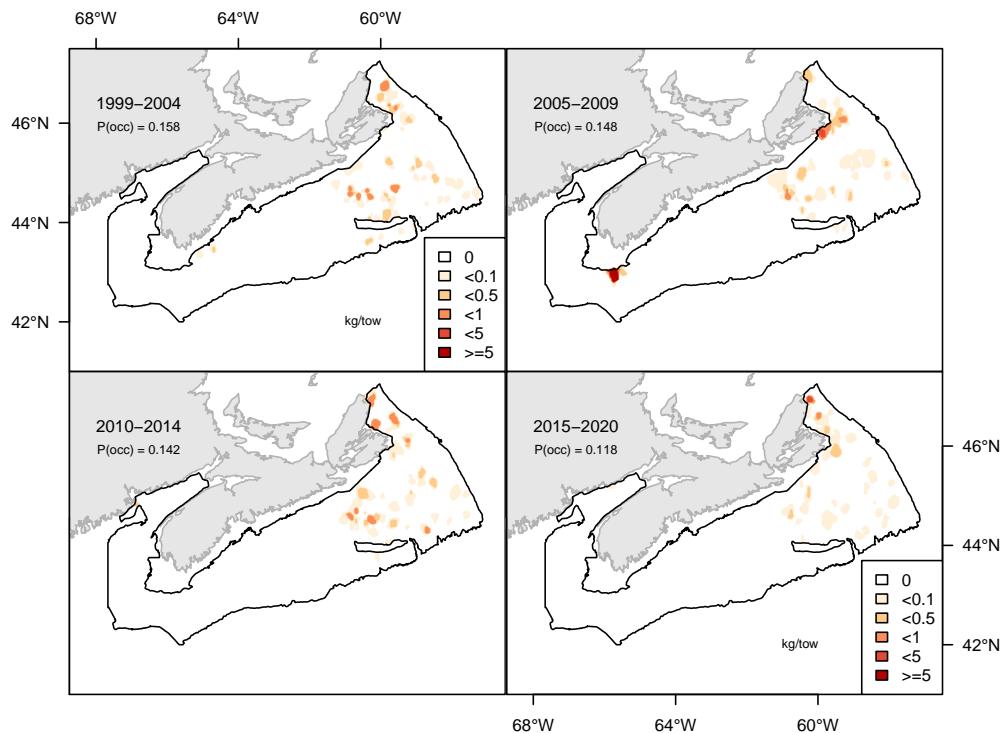


Figure 7.57A. Inverse distance weighted distribution of catch biomass (kg/tow) for Great spider crab.

1080

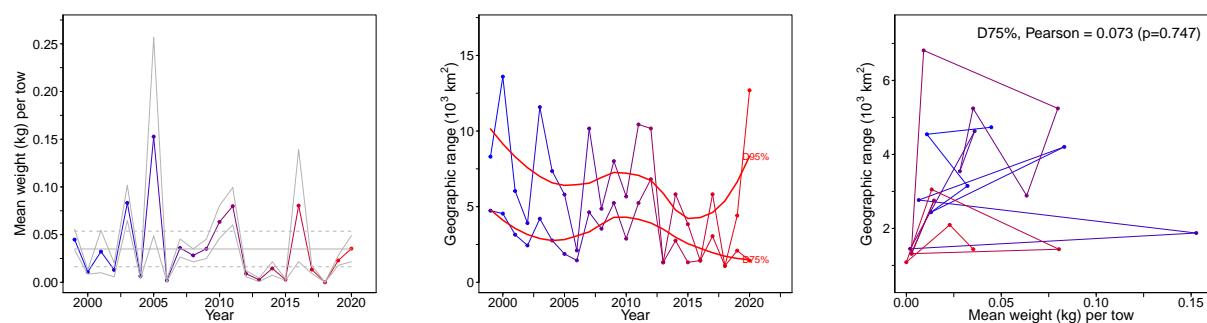


Figure 7.57B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Great spider crab.

1081

7.58 American lobster (Homard américain) - species code 2550 (category SF)

1082

Scientific name: [Homarus americanus](#)

1083

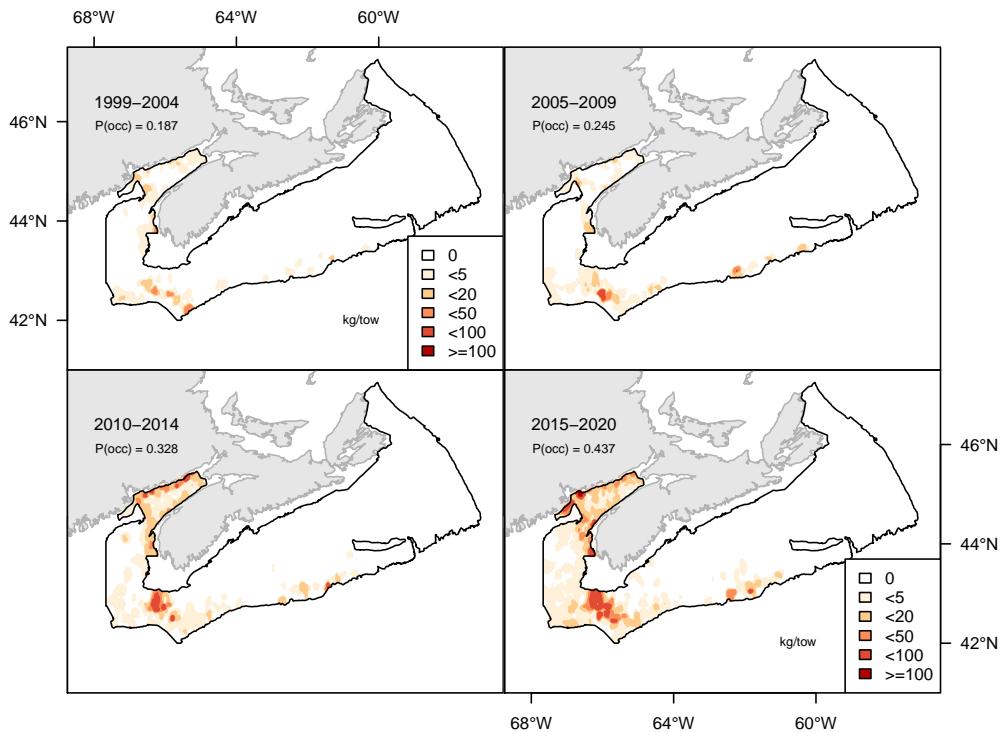


Figure 7.58A. Inverse distance weighted distribution of catch biomass (kg/tow) for American lobster.

1084

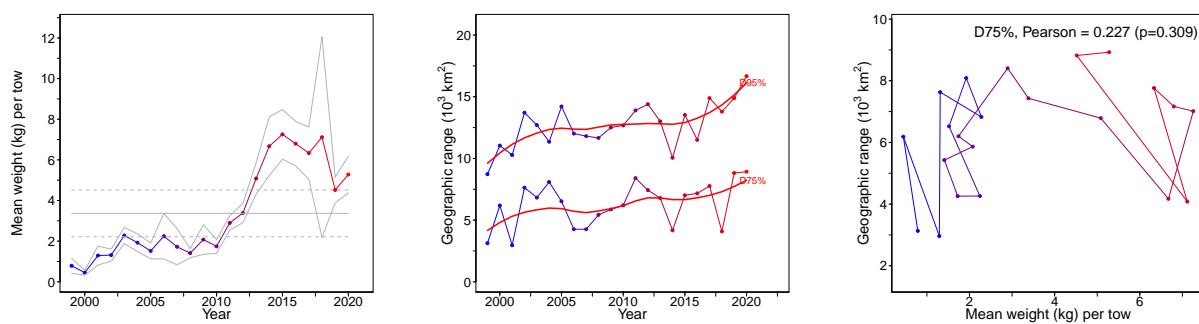


Figure 7.58B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American lobster.

1085

7.59 Sea lamprey (*Lamproie marine*) - species code 240 (category LR)

1086

Scientific name: [Petromyzon marinus](#)

1087

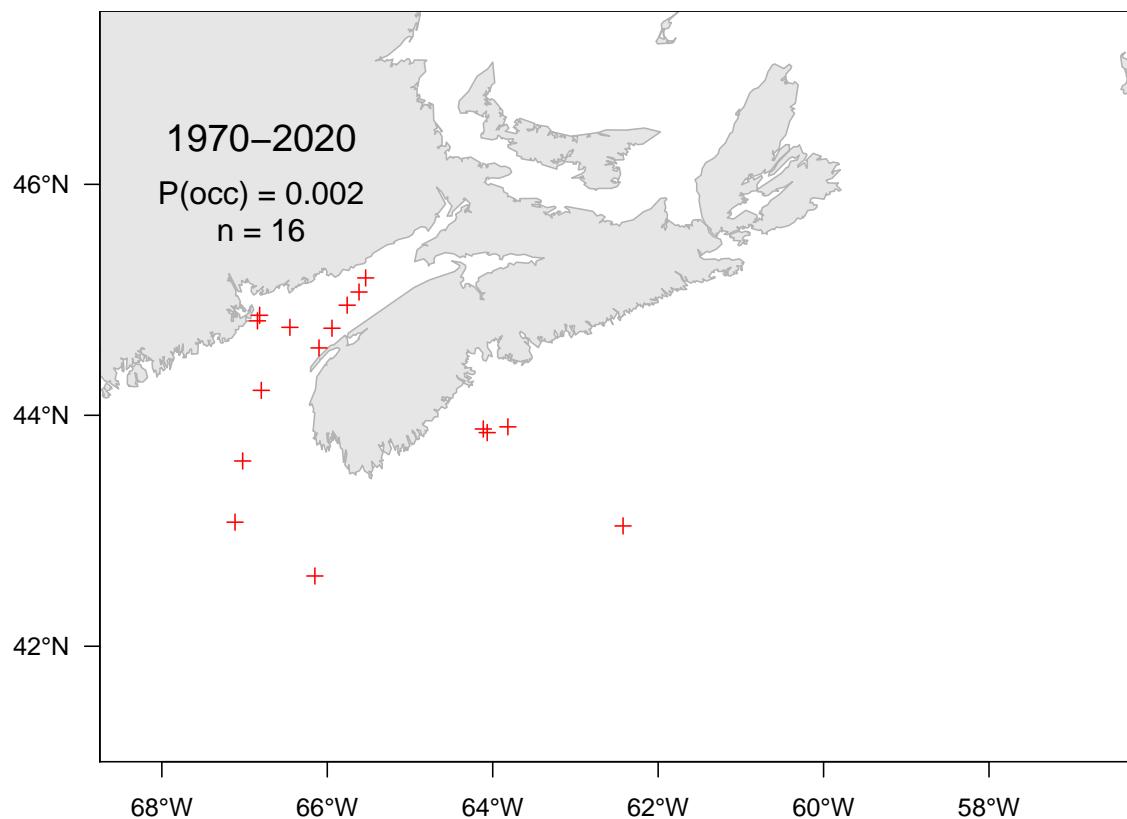


Figure 7.59A. Catch distribution for Sea lamprey.

1088

7.60 Atlantic tomcod (*Poulamon atlantique*) - species code 17 (category LR)

1089

Scientific name: [Microgadus tomcod](#)

1090

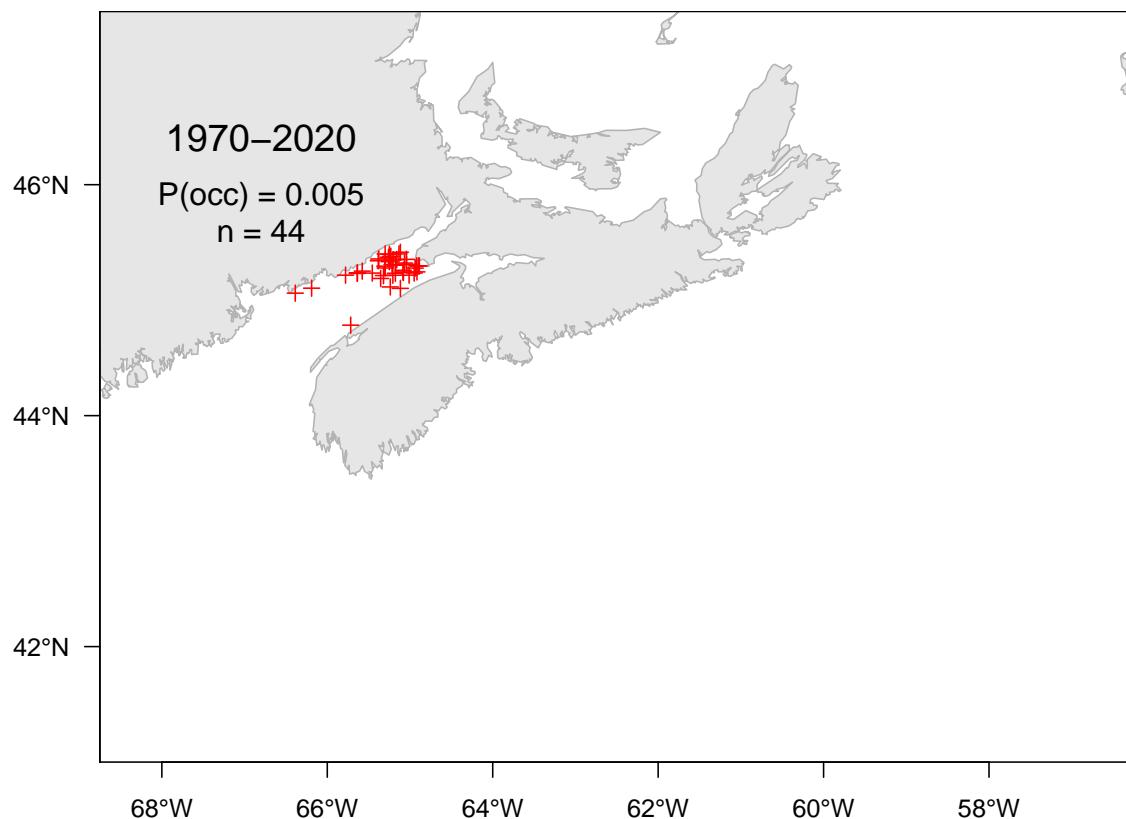


Figure 7.60A. Catch distribution for Atlantic tomcod.

1091

7.61 Offshore silver hake (Merlu argenté du large) - species code 19 (category LR)

1092

Scientific name: [Merluccius albidus](#)

1093

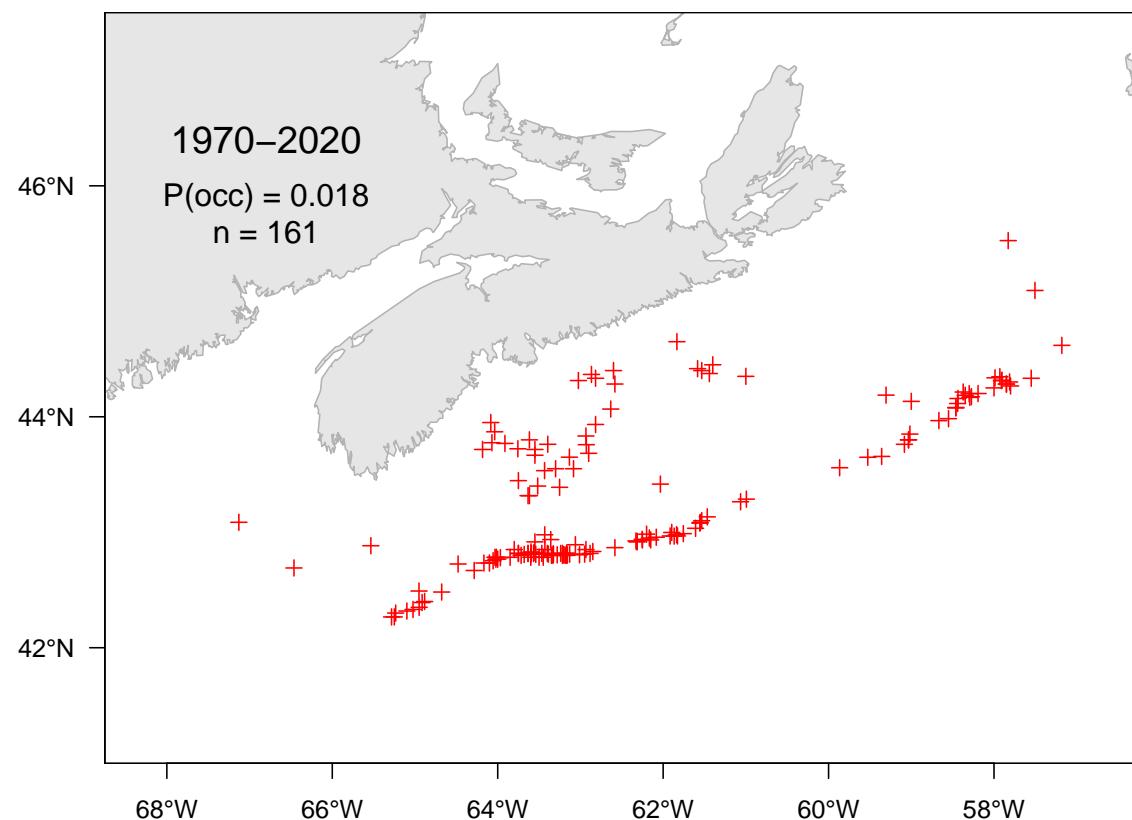


Figure 7.61A. Catch distribution for Offshore silver hake.

1094

7.62 Roughnose grenadier (Grenadier-scie) - species code 412 (category LR)

1095

Scientific name: [Trachyrincus murrayi](#)

1096

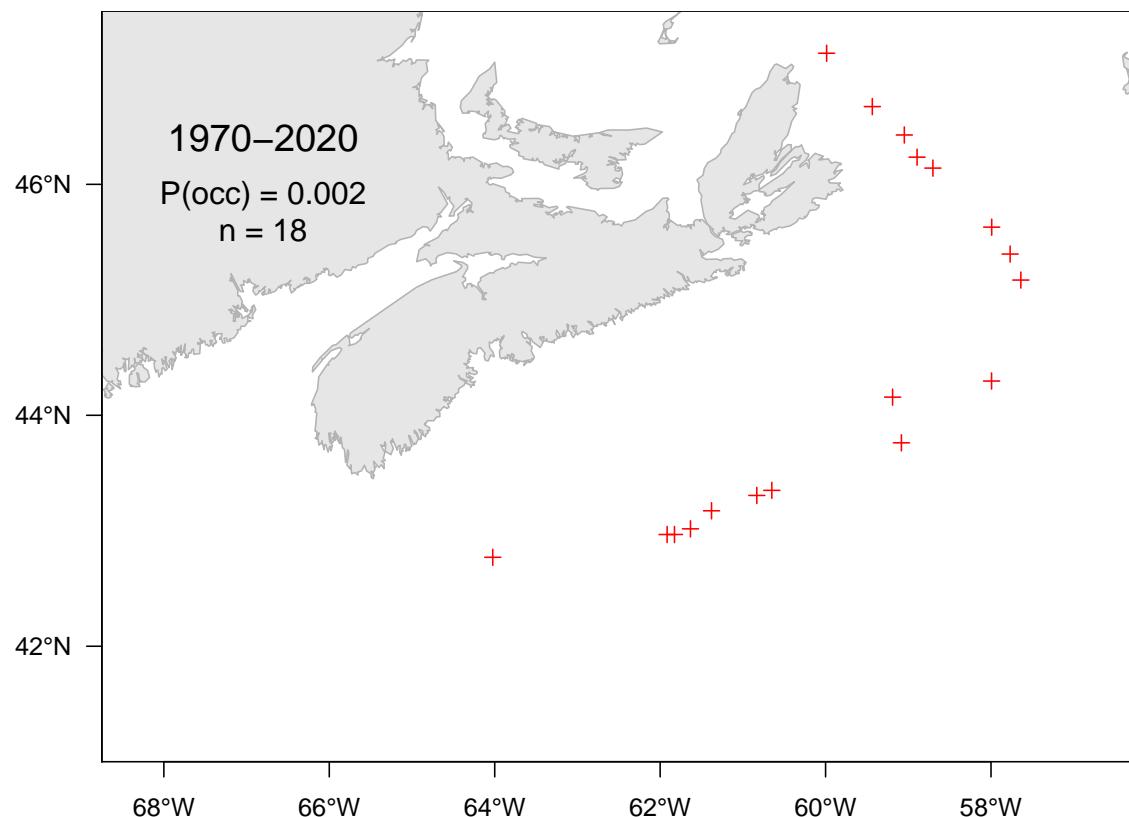


Figure 7.62A. Catch distribution for Roughnose grenadier.

1097

7.63 Roundnose grenadier (Grenadier de roche) - species code 414 (category LR)

1098

Scientific name: [Coryphaenoides rupestris](#)

1099

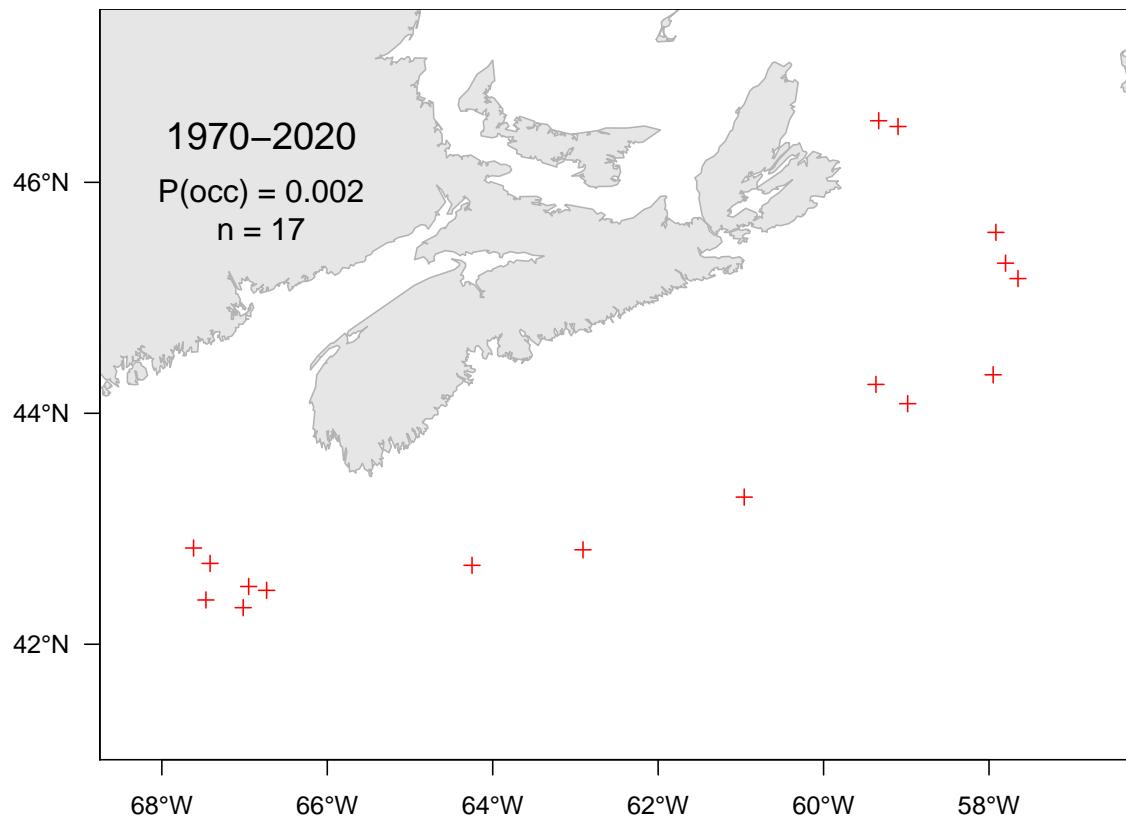


Figure 7.63A. Catch distribution for Roundnose grenadier.

1100 **7.64 Shorthorn sculpin (Chabosseau à épines courtes) - species code 301 (category**
1101 **LR)**

1102 Scientific name: [Myoxocephalus scorpius](#)

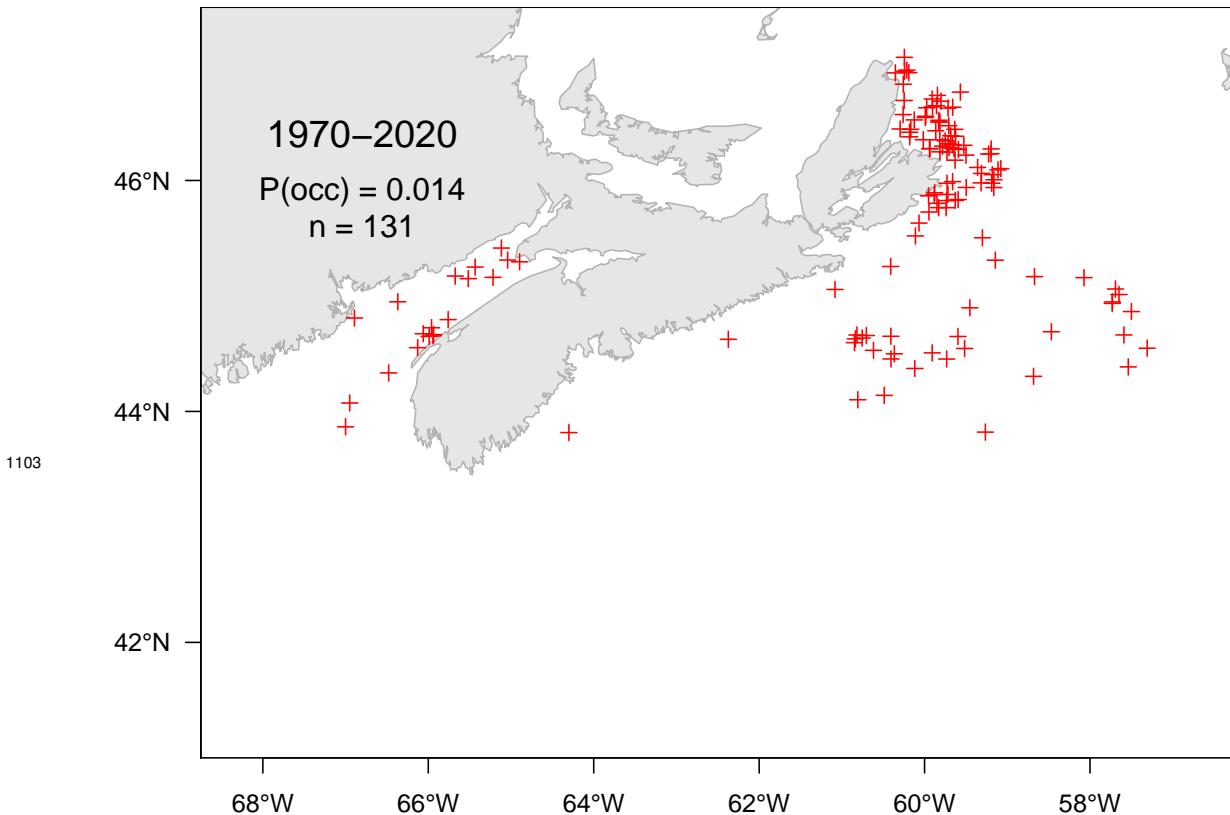


Figure 7.64A. Catch distribution for Shorthorn sculpin.

1104

7.65 Grubby (Chabosseau bronzé) - species code 303 (category LR)

1105

Scientific name: [Myoxocephalus aenaeus](#)

1106

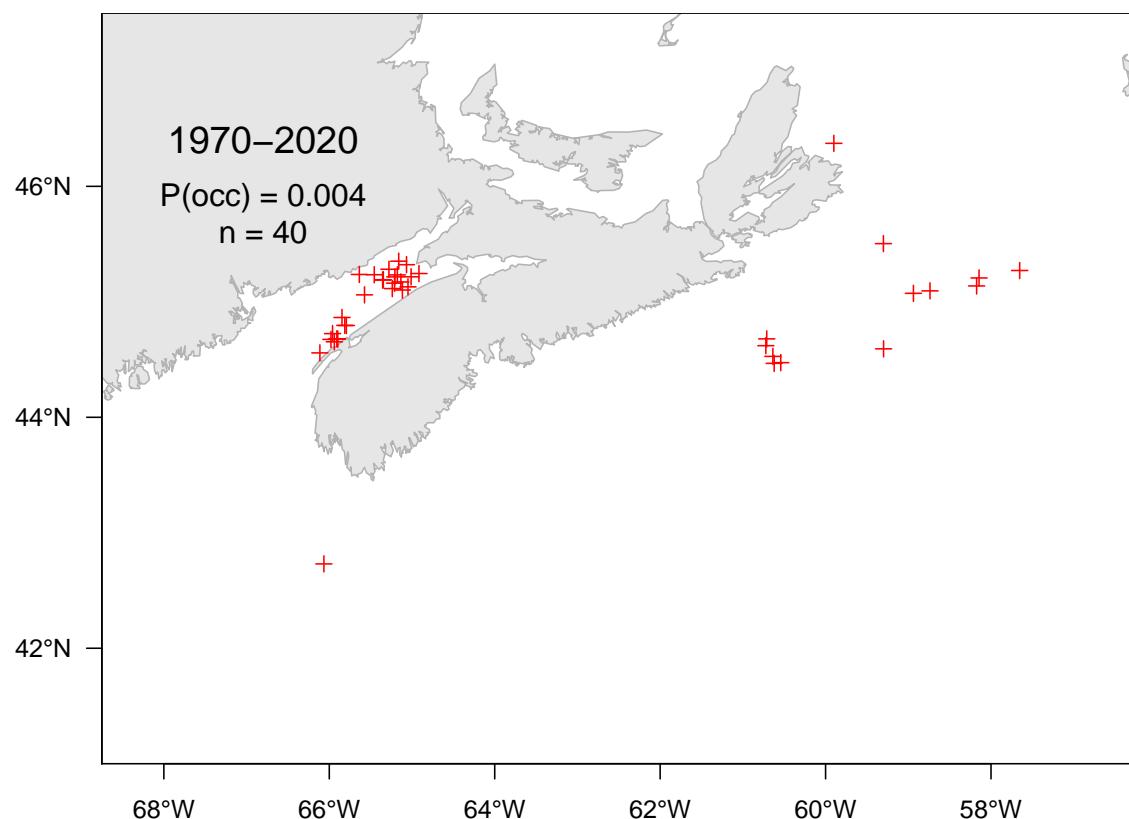


Figure 7.65A. Catch distribution for Grubby.

1107

7.66 Polar sculpin (Cotte polaire) - species code 307 (category LR)

1108

Scientific name: [Cottunculus microps](#)

1109

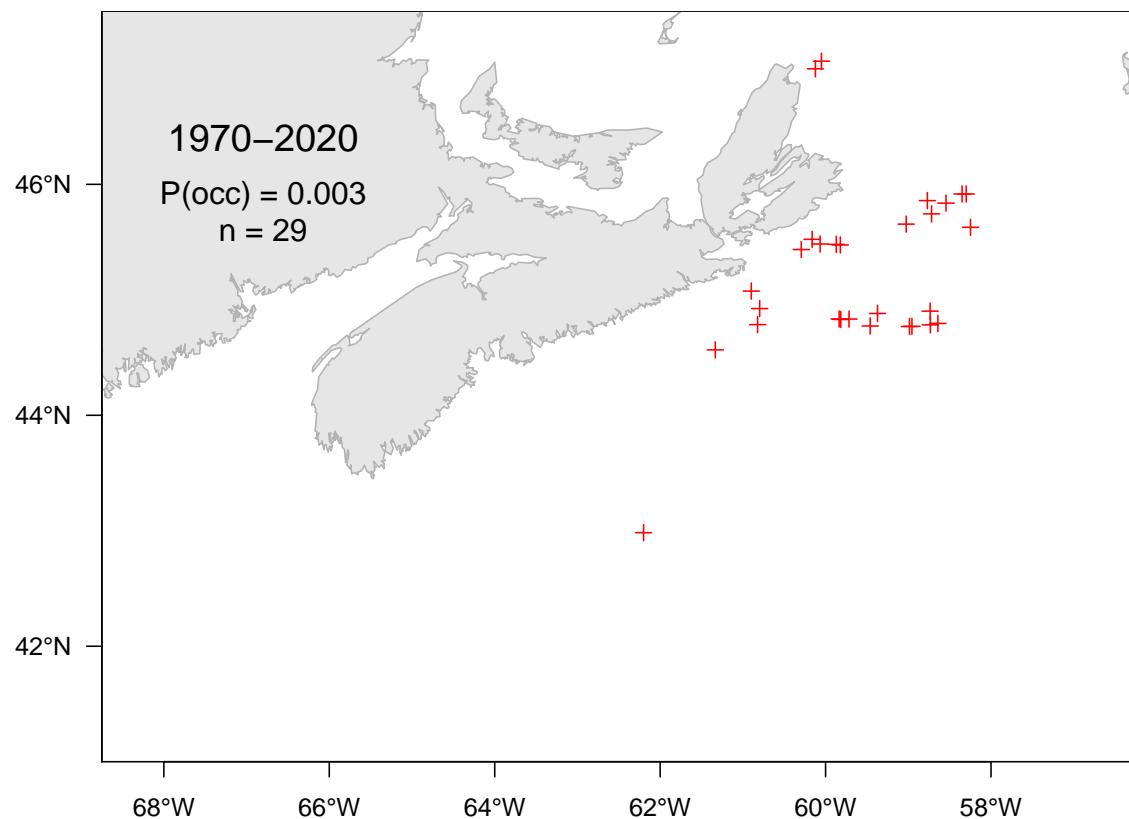
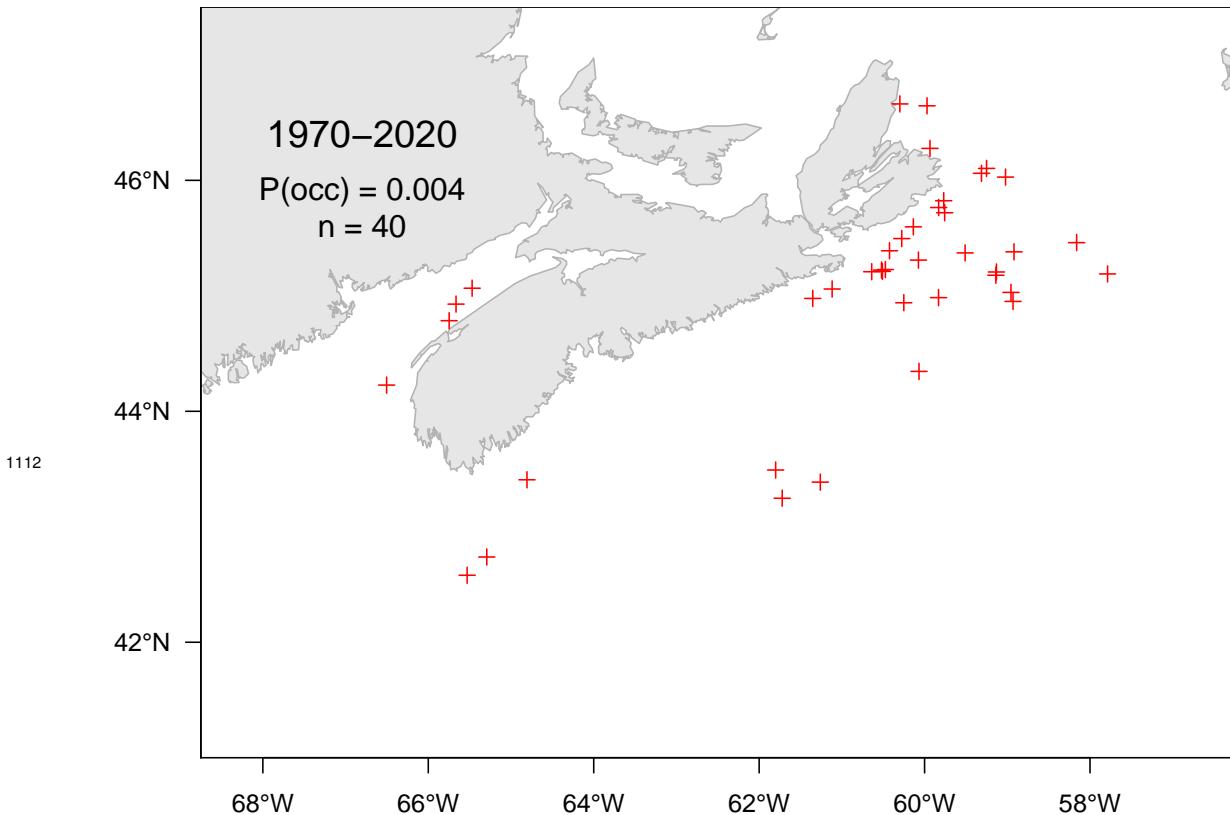


Figure 7.66A. Catch distribution for Polar sculpin.

1110 7.67 Spatulate sculpin (Icèle spatulée) - species code 314 (category LR)

1111 Scientific name: *Icelus spatula*



1113

7.68 Arctic alligatorfish (Poisson-alligator arctique) - species code 341 (category LR)

1114

Scientific name: [Ulcina olrikii](#)

1115

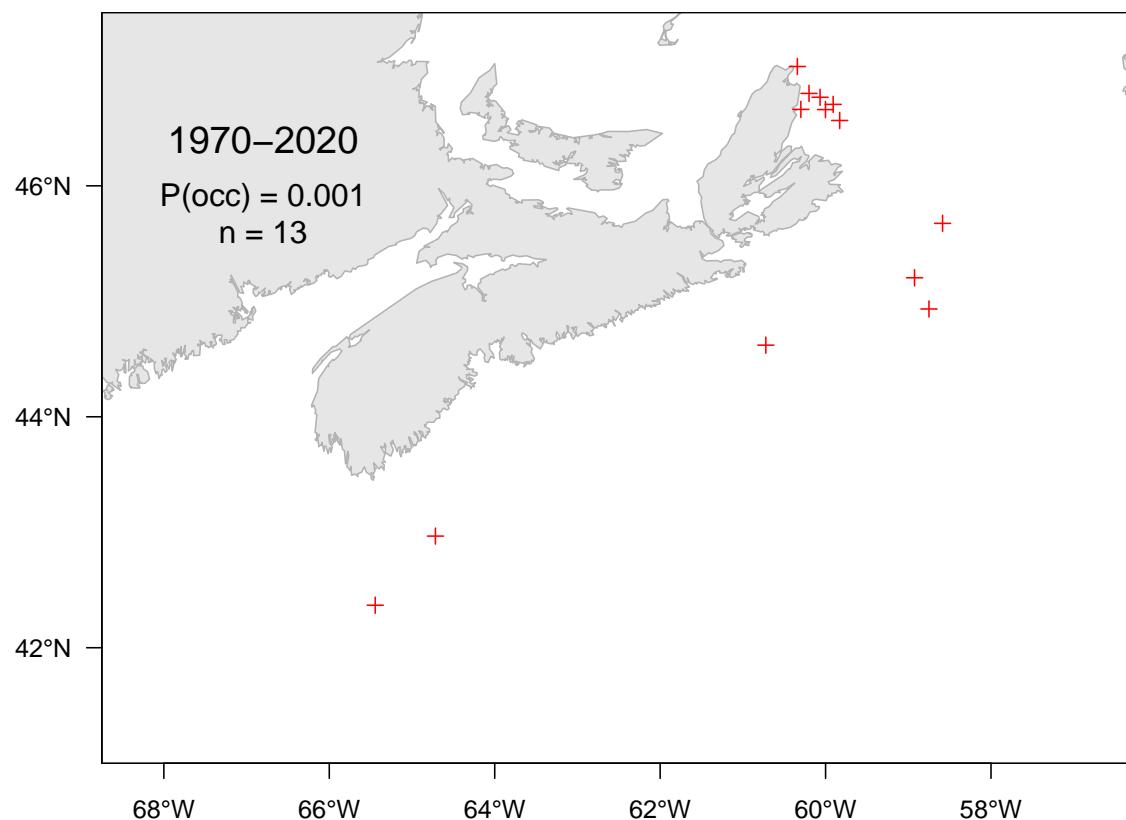


Figure 7.68A. Catch distribution for Arctic alligatorfish.

1116

7.69 Alligatorfishes (Poissons-alligator) - species code 351 (category LR)

1117

Scientific name: [Agonidae](#)

1118

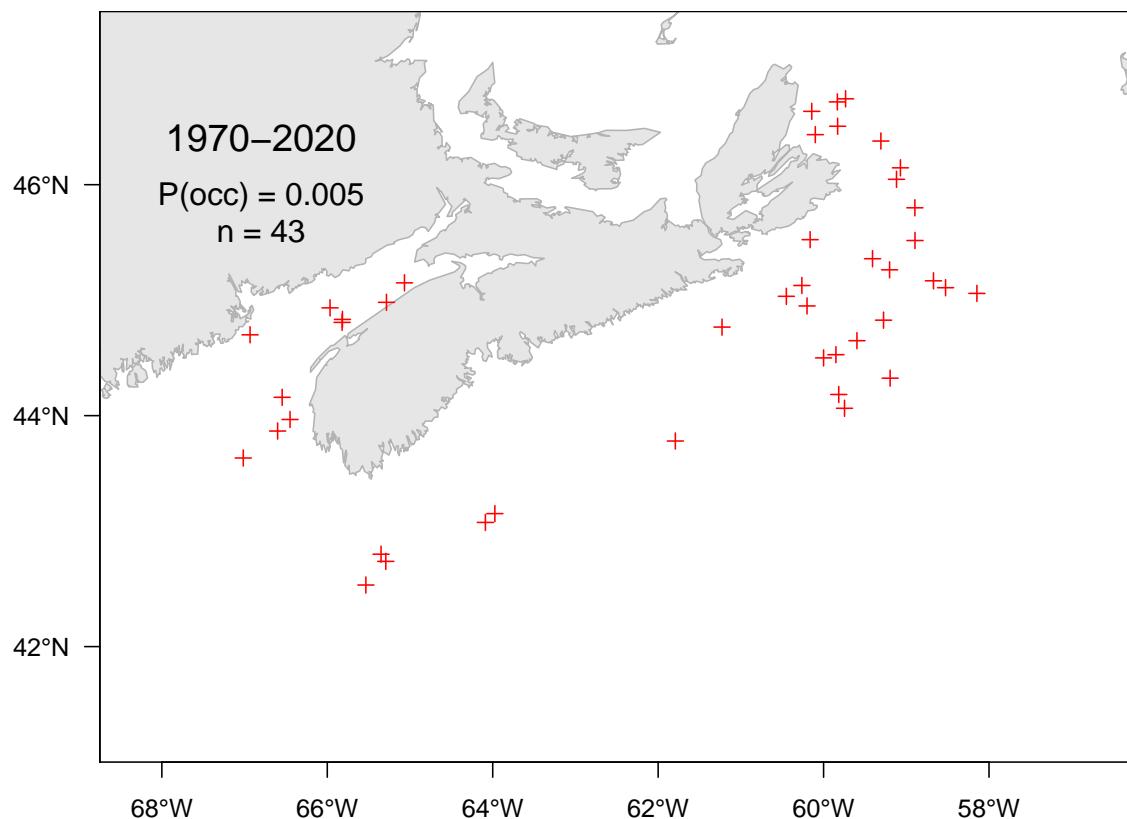


Figure 7.69A. Catch distribution for Alligatorfishes.

1119

7.70 Atlantic seasnail (*Limace atlantique*) - species code 503 (category LR)

1120

Scientific name: [Liparis atlanticus](#)

1121

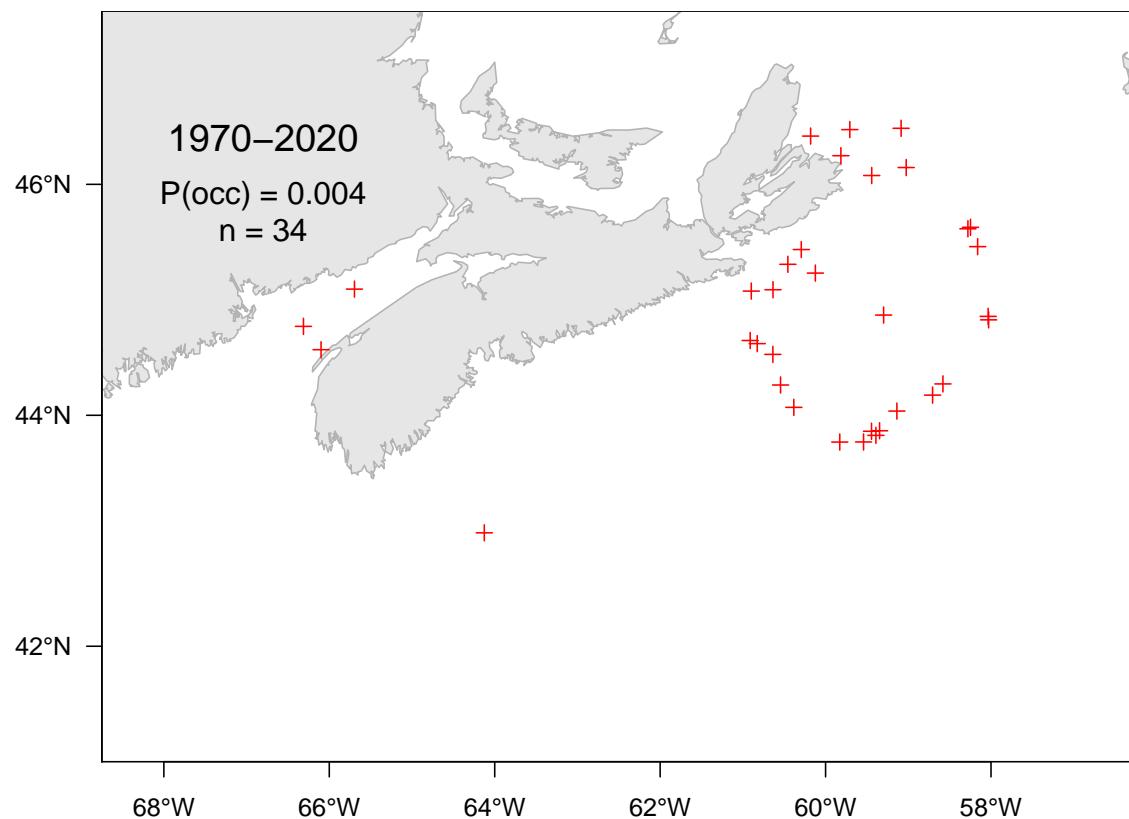


Figure 7.70A. Catch distribution for Atlantic seasnail.

1122 7.71 Gelatinous snailfish (Limace gélatineuse) - species code 505 (category LR)

1123 Scientific name: [Liparis fabricii](#)

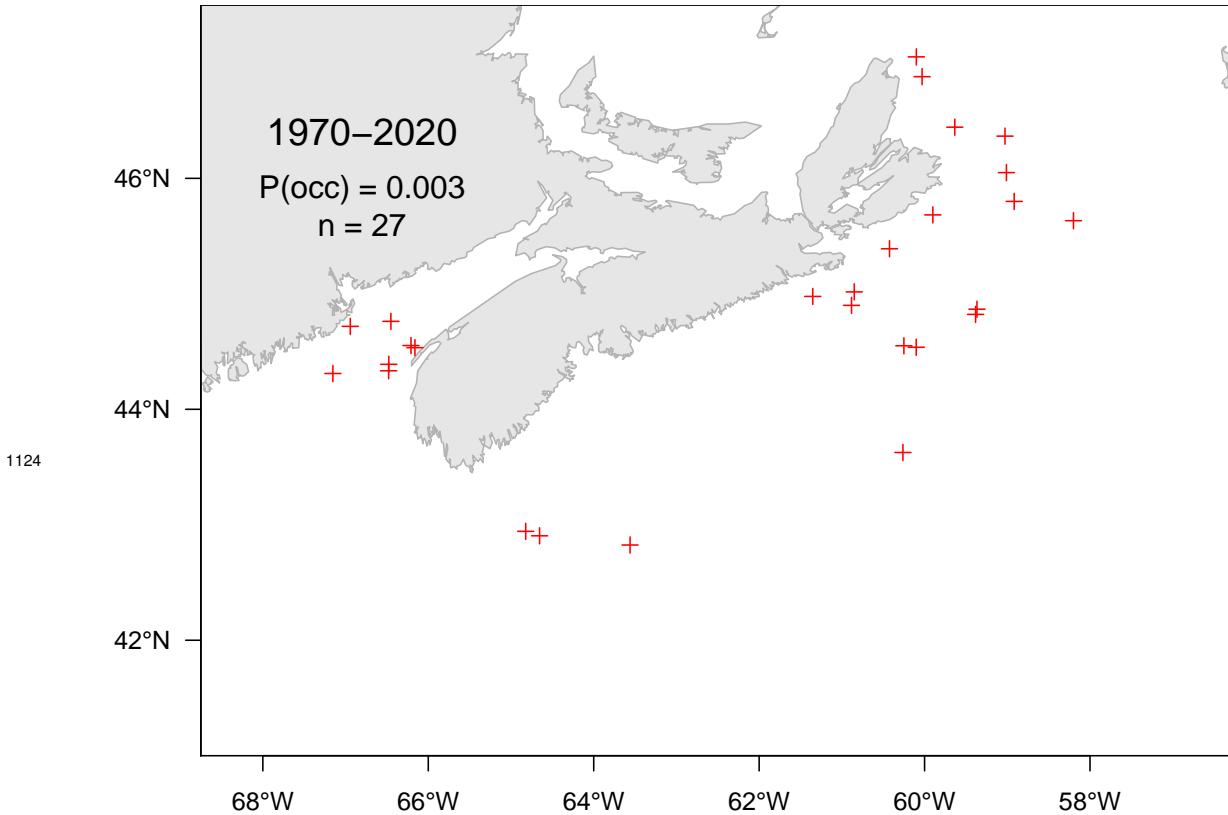


Figure 7.71A. Catch distribution for Gelatinous snailfish.

1125 **7.72 Variegated snailfish (*Limace marbée*) - species code 512 (category LR)**

1126 Scientific name: [Liparis gibbus](#)

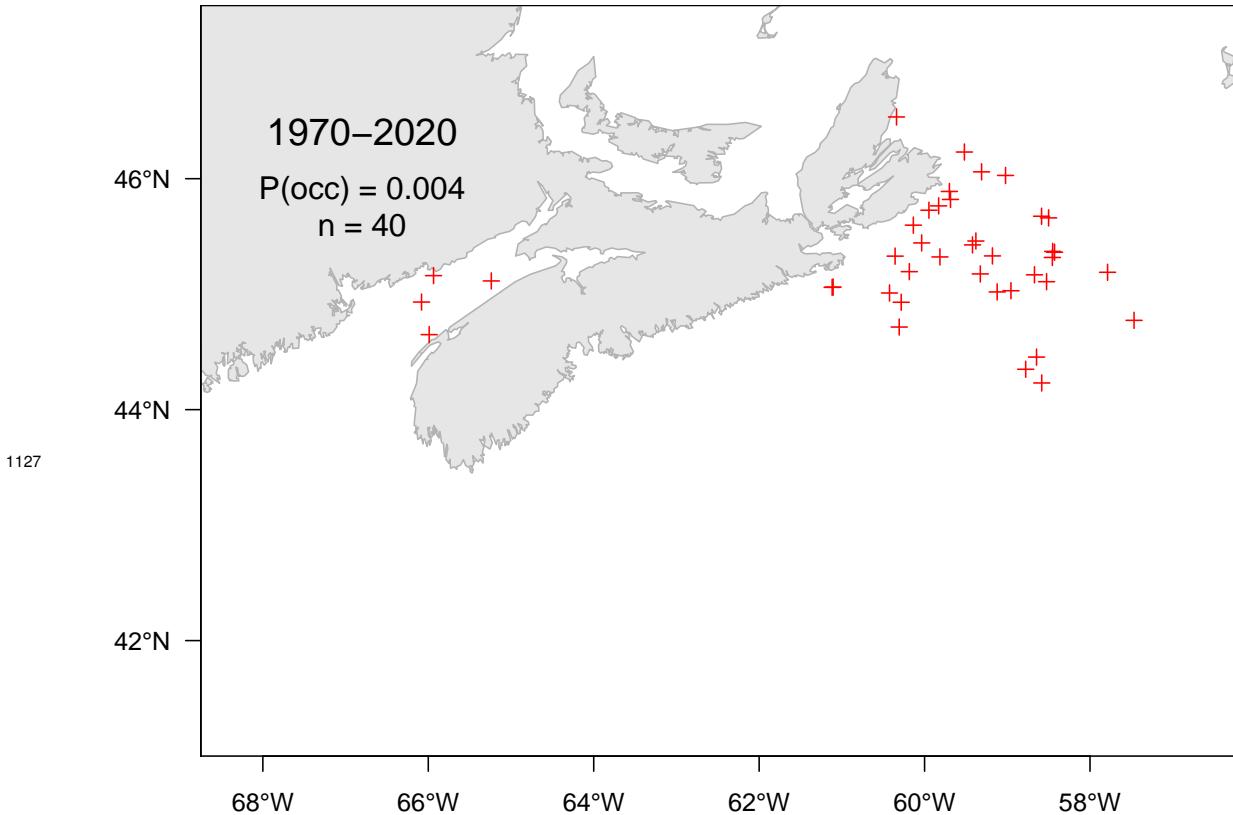


Figure 7.72A. Catch distribution for Variegated snailfish.

1128

7.73 Sea tadpole (Petite limace de mer) - species code 520 (category LR)

1129

Scientific name: [Careproctus reinhardtii](#)

1130

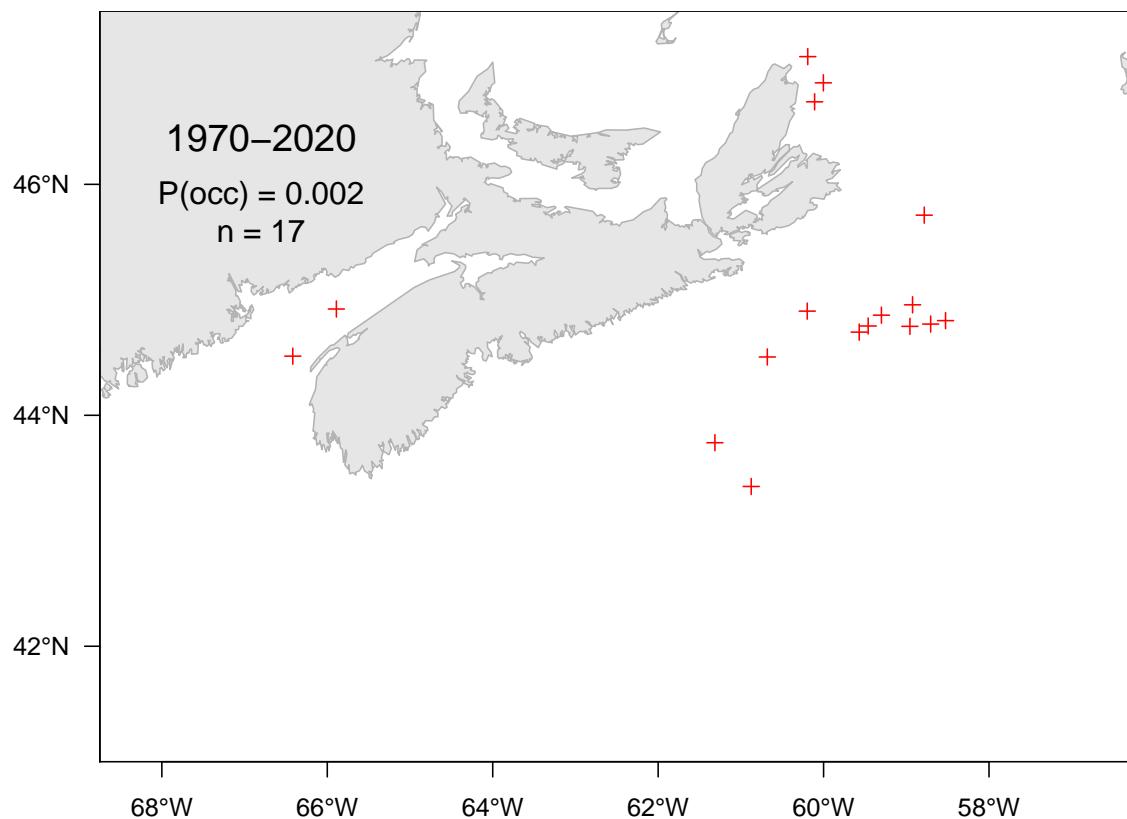


Figure 7.73A. Catch distribution for Sea tadpole.

1131

7.74 Fourspot flounder (Cardeau à quatre ocelles) - species code 142 (category LR)

1132

Scientific name: [Hippoglossina oblonga](#)

1133

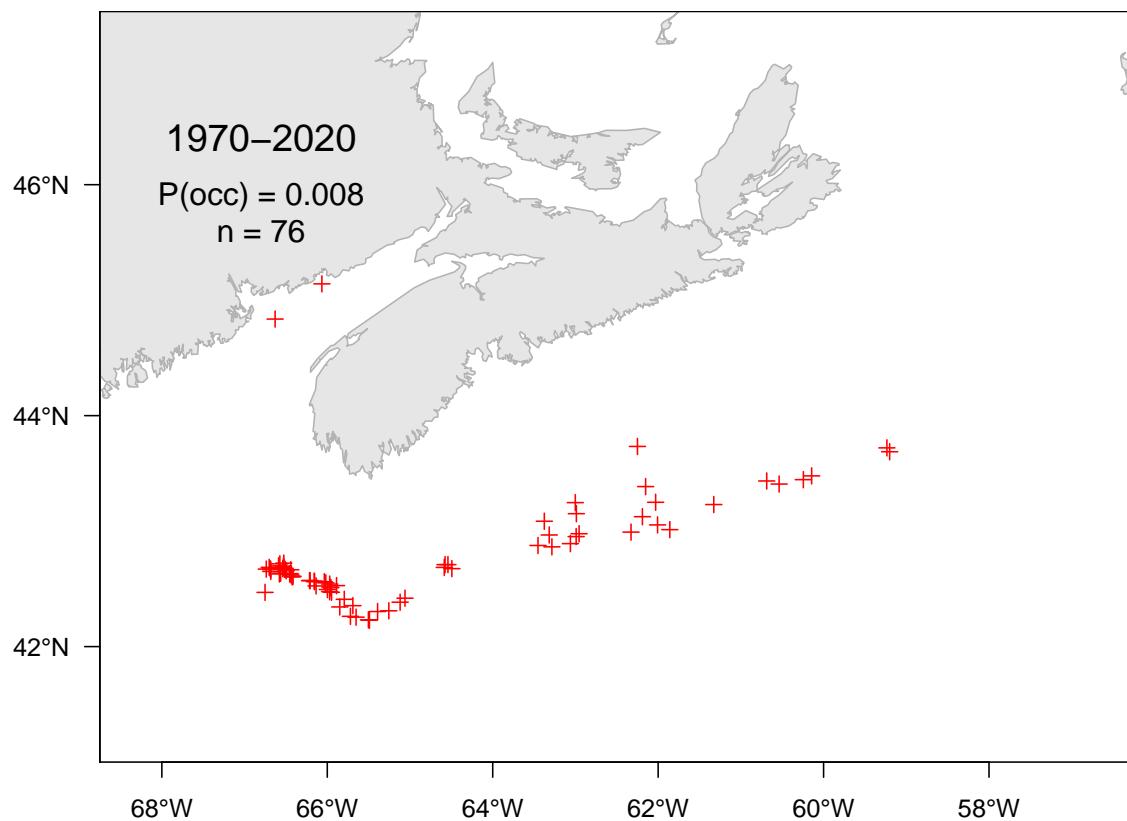


Figure 7.74A. Catch distribution for Fourspot flounder.

1134

7.75 Windowpane flounder (Turbot de sable) - species code 143 (category LR)

1135

Scientific name: [Scophthalmus aquosus](#)

1136

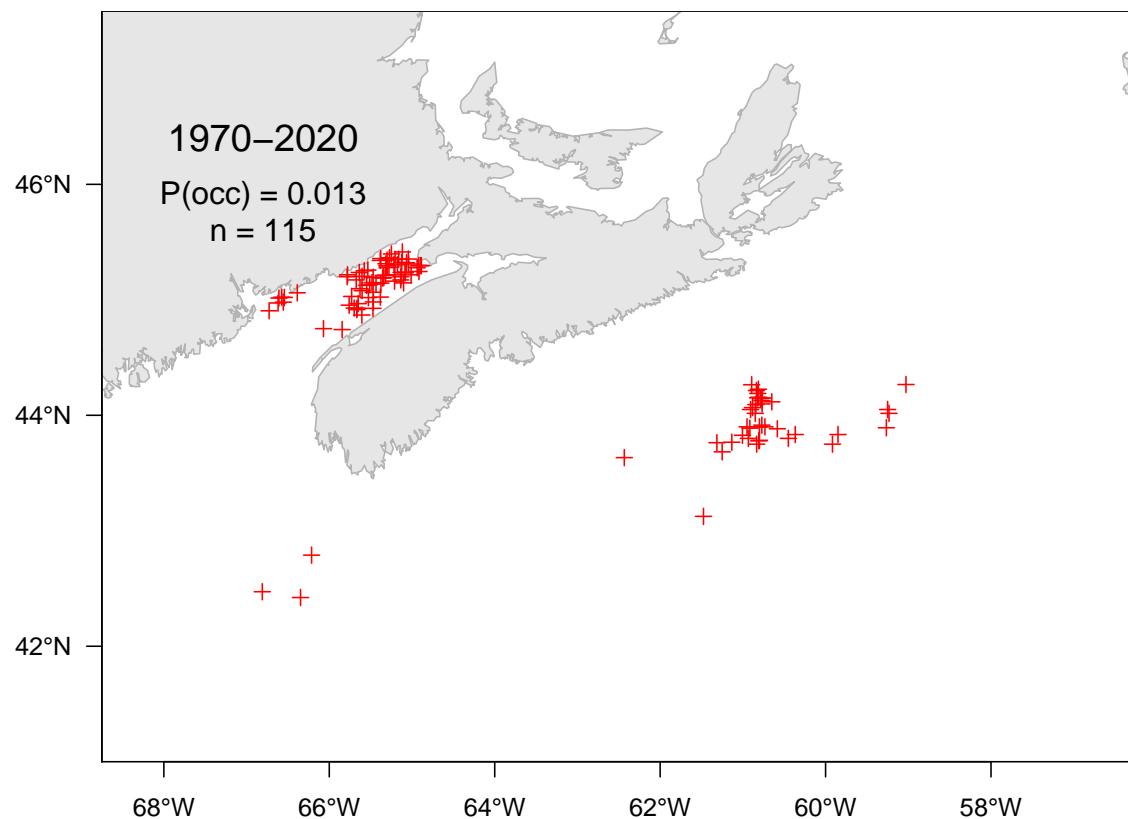


Figure 7.75A. Catch distribution for Windowpane flounder.

1137

7.76 Spottedfin tonguefish (Langue fil noir) - species code 816 (category LR)

1138

Scientific name: [Symphurus diomedeanus](#)

1139

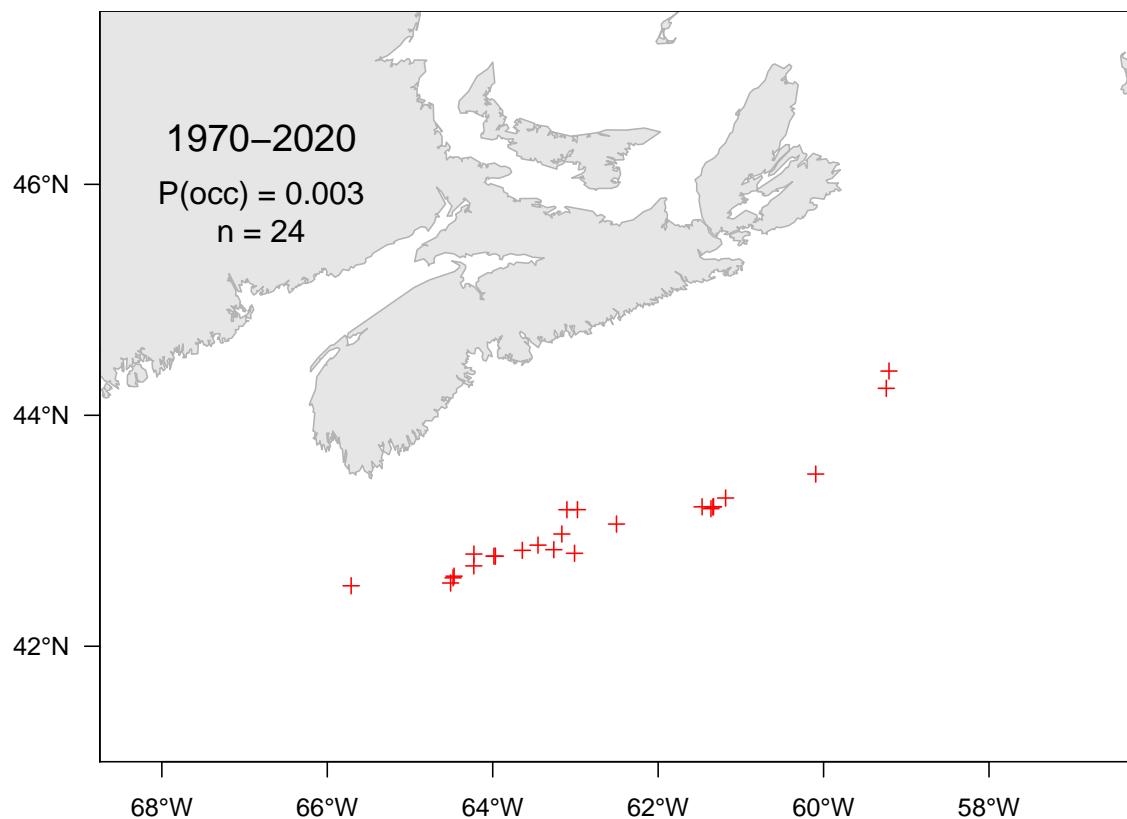


Figure 7.76A. Catch distribution for Spottedfin tonguefish.

1140

7.77 Spotted wolffish (*Loup tacheté*) - species code 51 (category LR)

1141

Scientific name: [Anarhichas minor](#)

1142

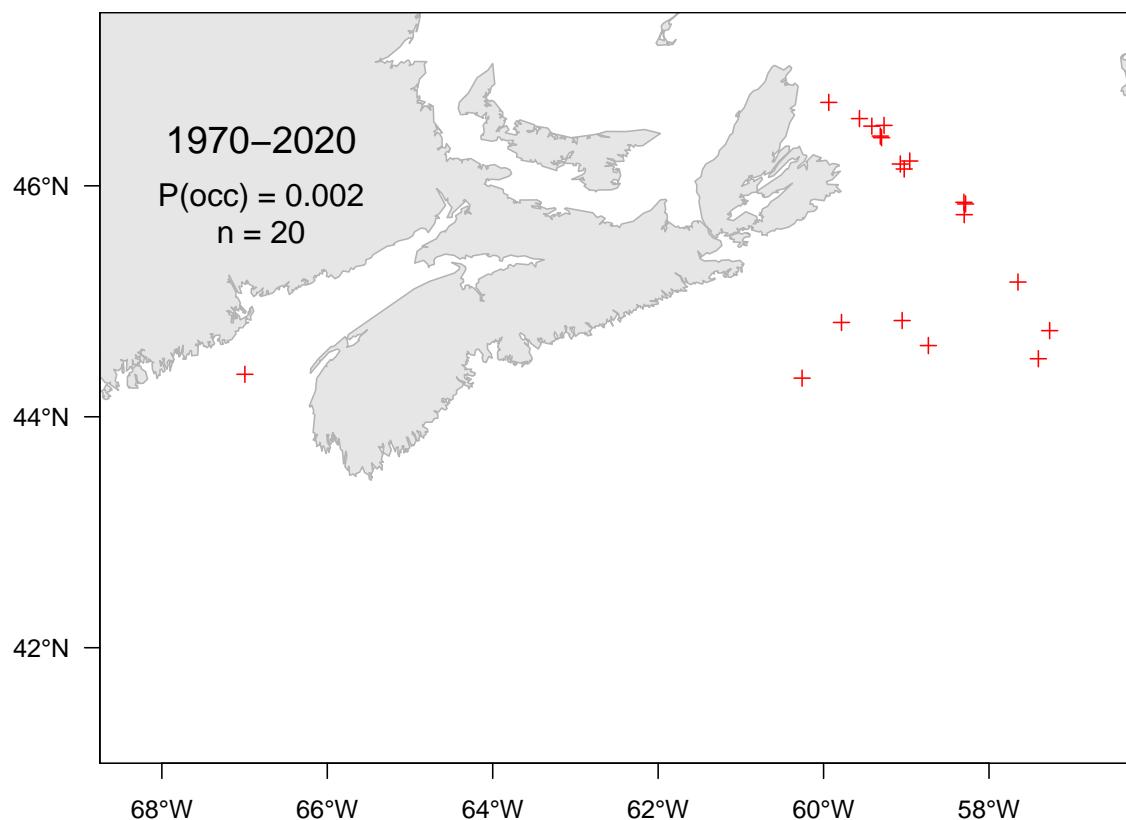


Figure 7.77A. Catch distribution for Spotted wolffish.

1143

7.78 Northern wolffish (Loup à tête large) - species code 52 (category LR)

1144

Scientific name: [Anarhichas denticulatus](#)

1145

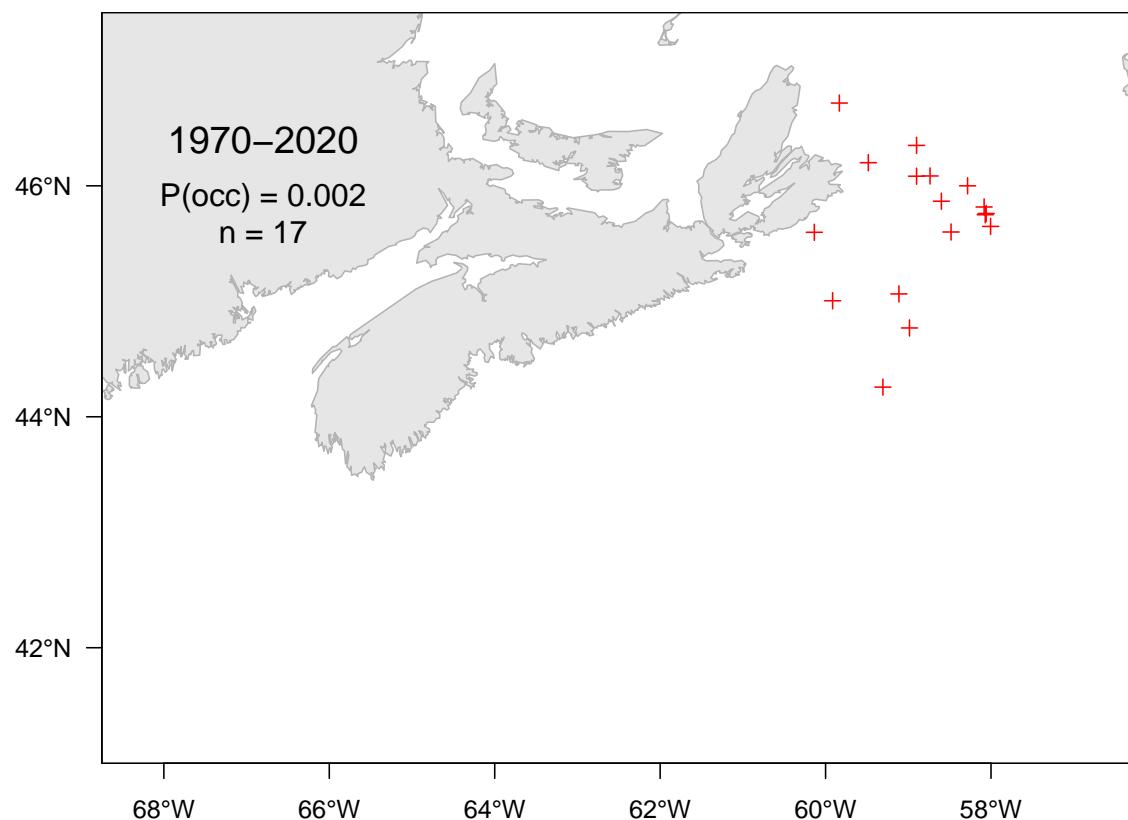


Figure 7.78A. Catch distribution for Northern wolffish.

1146

7.79 Cunner (Tanche-tautogue) - species code 122 (category LR)

1147

Scientific name: [Tautogolabrus adspersus](#)

1148

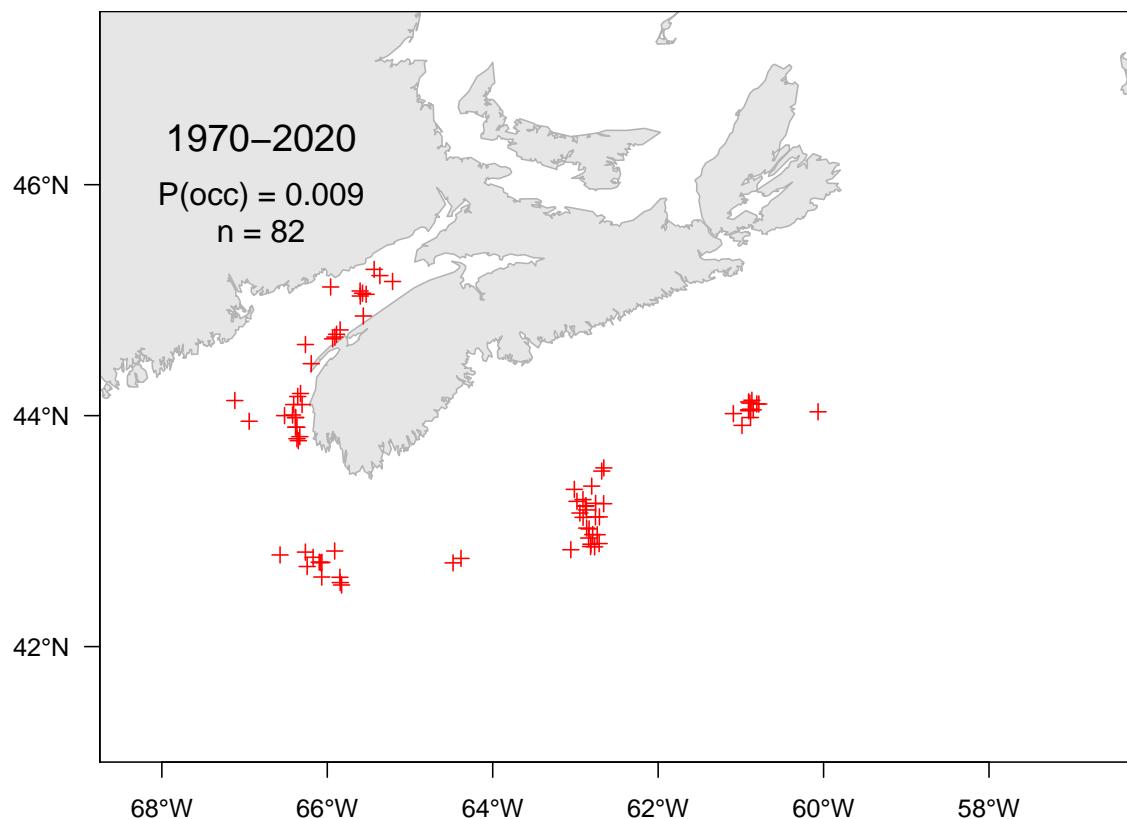


Figure 7.79A. Catch distribution for Cunner.

1149

7.80 Wolf eelpout (*Lycodes à tête longue*) - species code 603 (category LR)

1150

Scientific name: [Lycenchelys verrillii](#)

1151

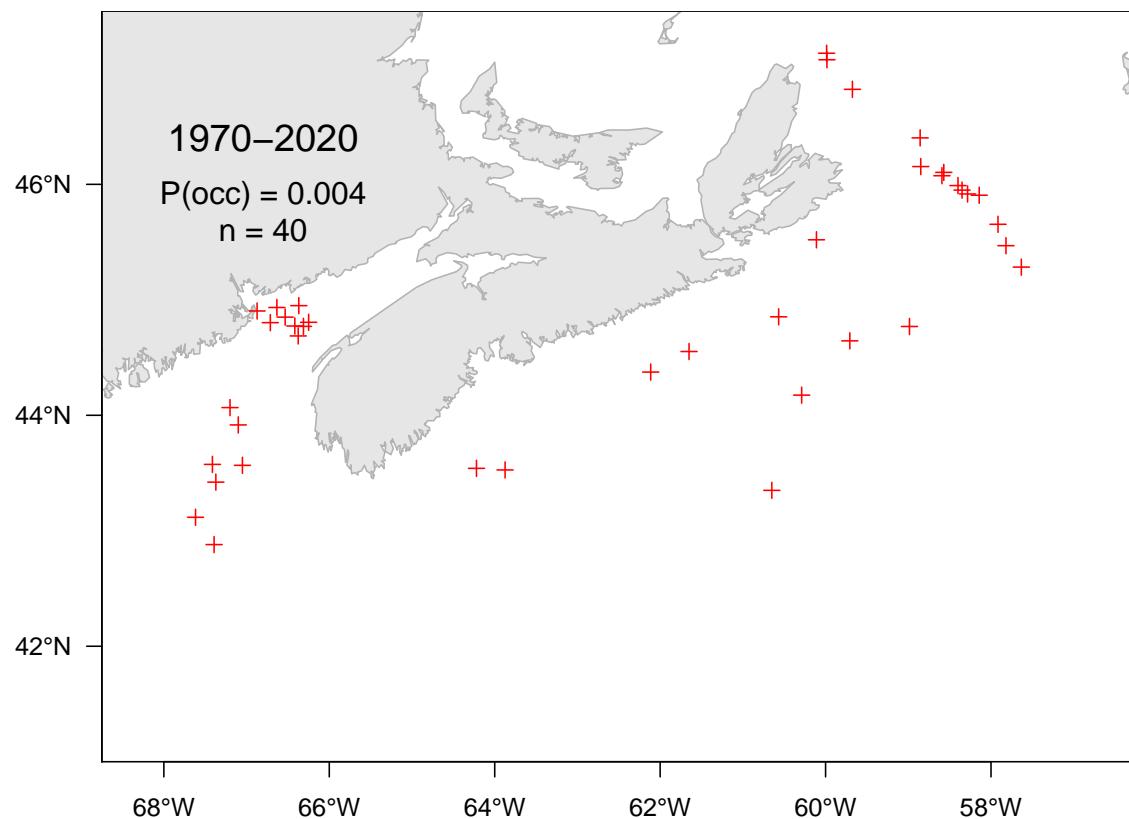


Figure 7.80A. Catch distribution for Wolf eelpout.

1152

7.81 Newfoundland eelpout (*Lycodes* du Labrador) - species code 619 (category LR)

1153

Scientific name: [Lycodes terraenovae](#)

1154

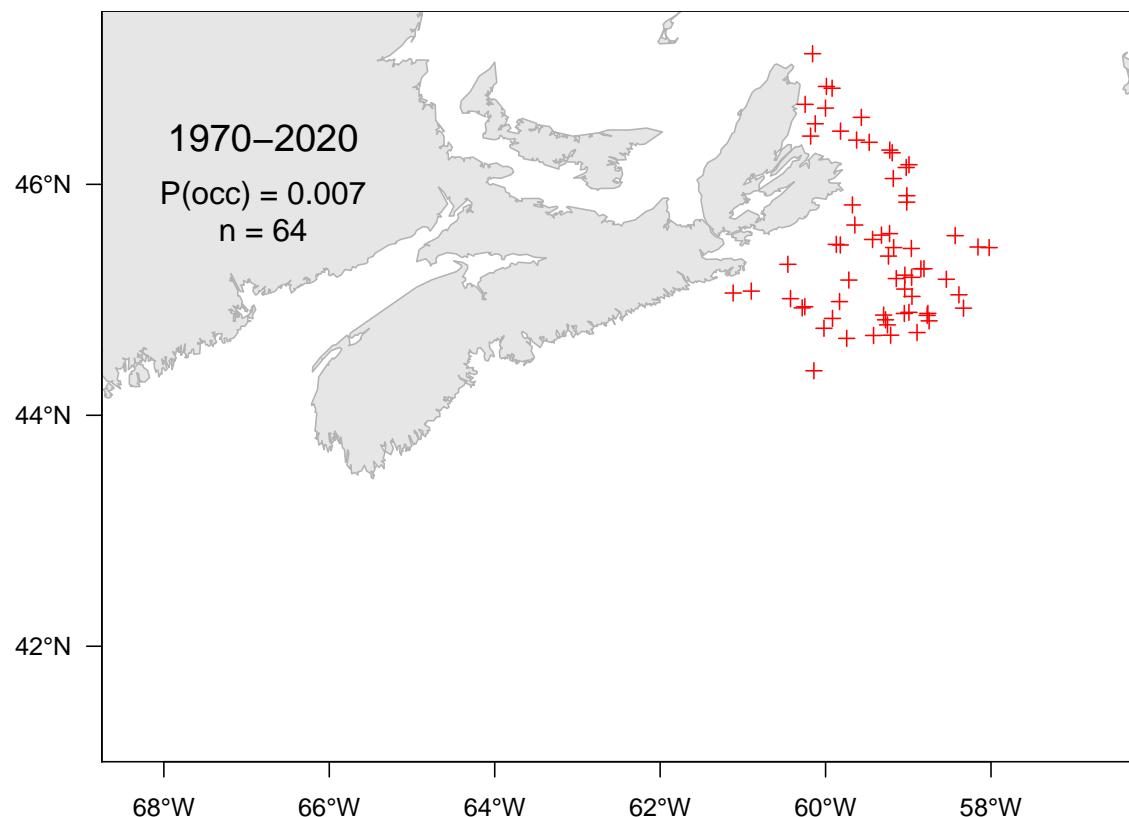


Figure 7.81A. Catch distribution for Newfoundland eelpout.

1155

7.82 Newfoundland eelpout (*Lycodes lavalaei*) - species code 620 (category LR)

1156

Scientific name: [Lycodes lavalaei](#)

1157

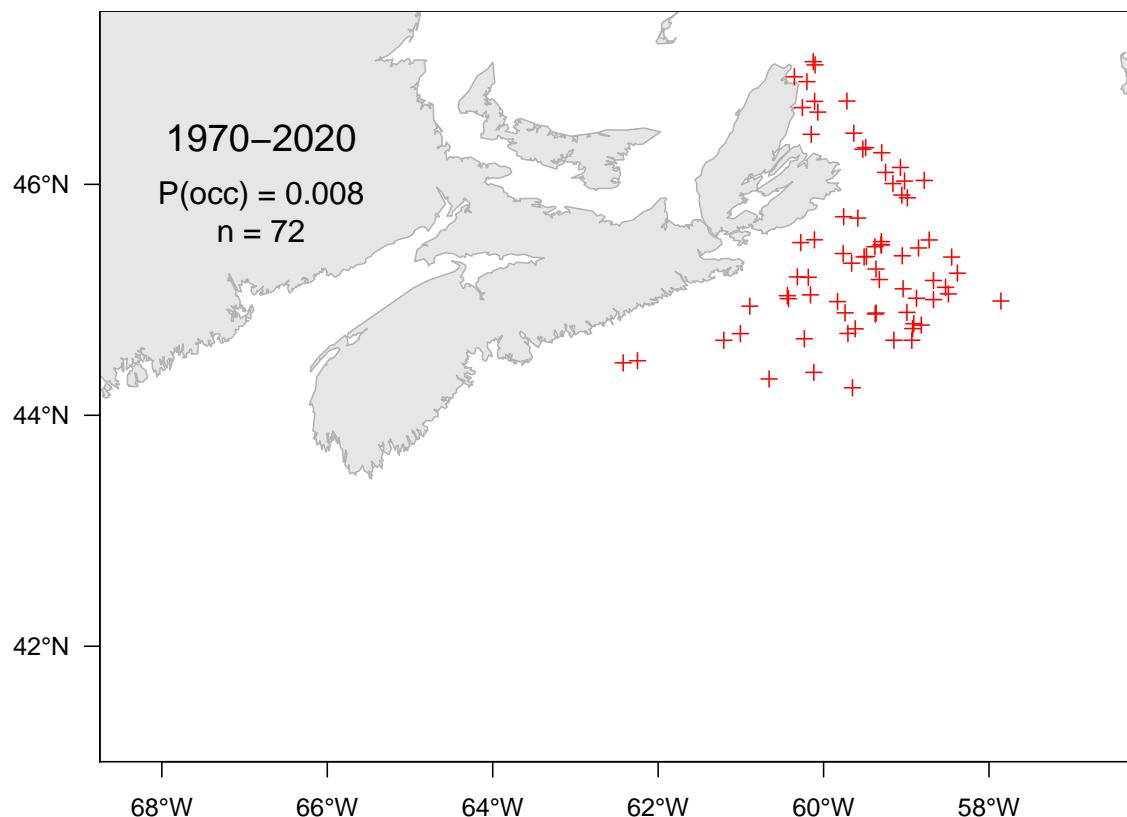


Figure 7.82A. Catch distribution for Newfoundland eelpout.

1158

7.83 Rock gunnel (Sigouine de roche) - species code 621 (category LR)

1159

Scientific name: [Pholis gunnellus](#)

1160

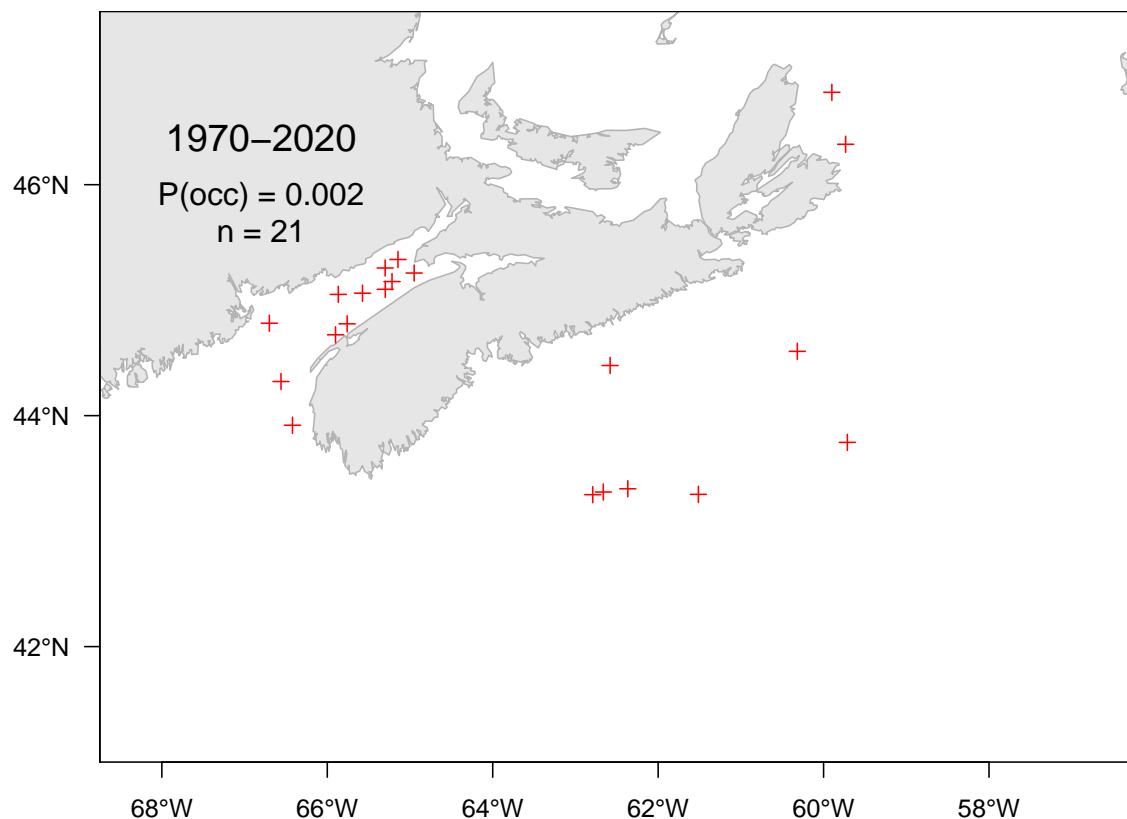


Figure 7.83A. Catch distribution for Rock gunnel.

1161

7.84 Radiated shanny (*Ulvaire deux-lignes*) - species code 625 (category LR)

1162

Scientific name: [Ulvaria subbifurcata](#)

1163

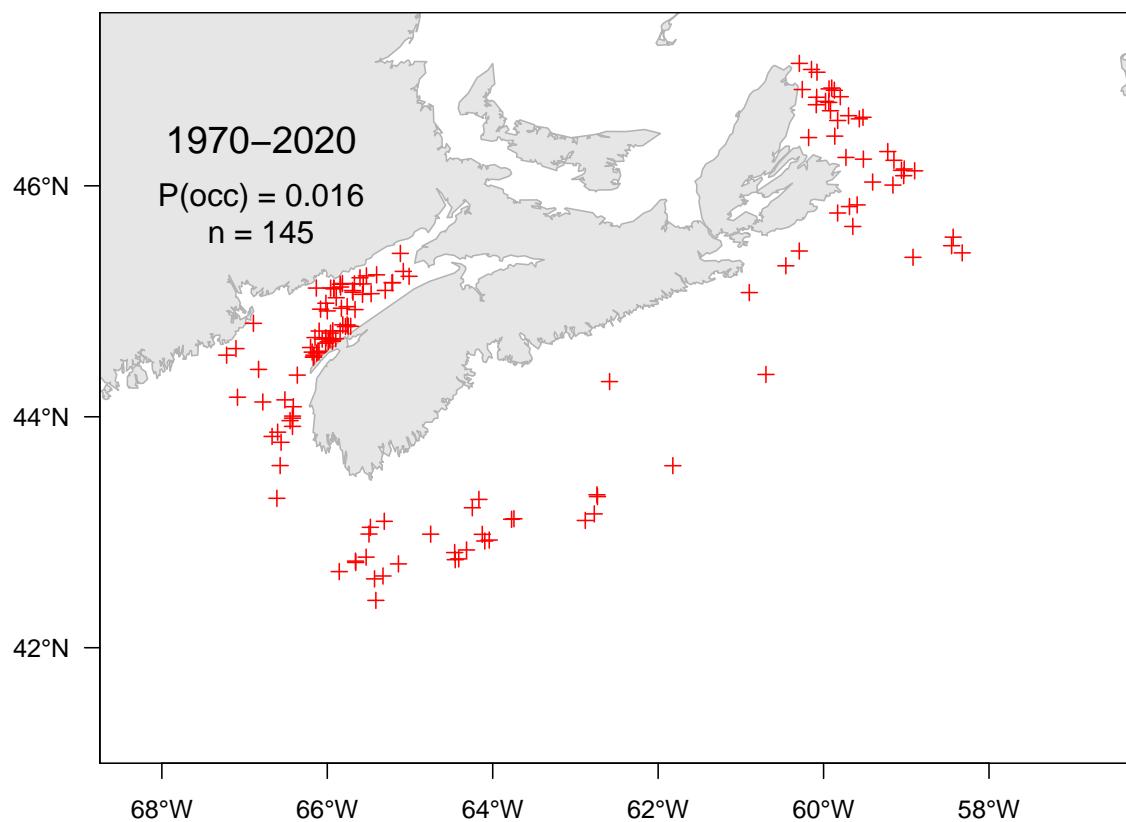


Figure 7.84A. Catch distribution for Radiated shanny.

1164

7.85 Fourline snakeblenny (Quatre-lignes atlantique) - species code 626 (category LR)

1165

Scientific name: [Eumesogrammus praecisus](#)

1166

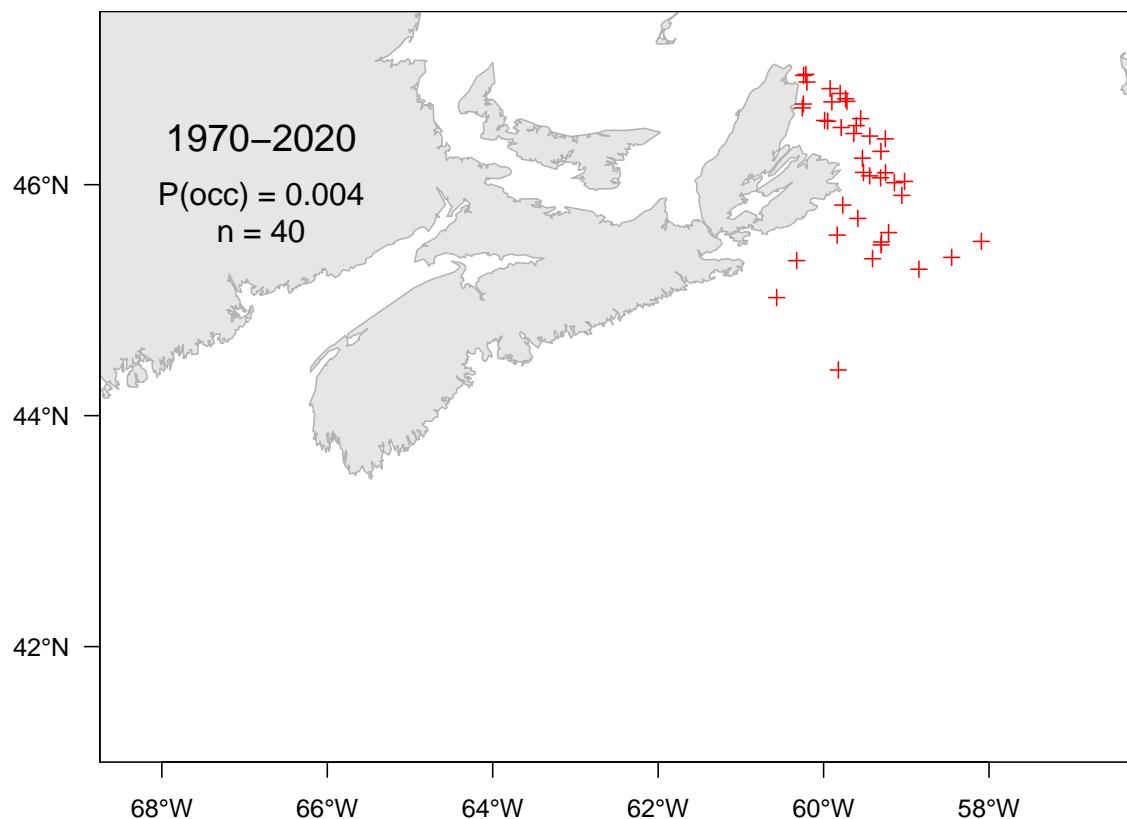


Figure 7.85A. Catch distribution for Fourline snakeblenny.

1167

7.86 Wrymouth (Terrassier tacheté) - species code 630 (category LR)

1168

Scientific name: [Cryptacanthodes maculatus](#)

1169

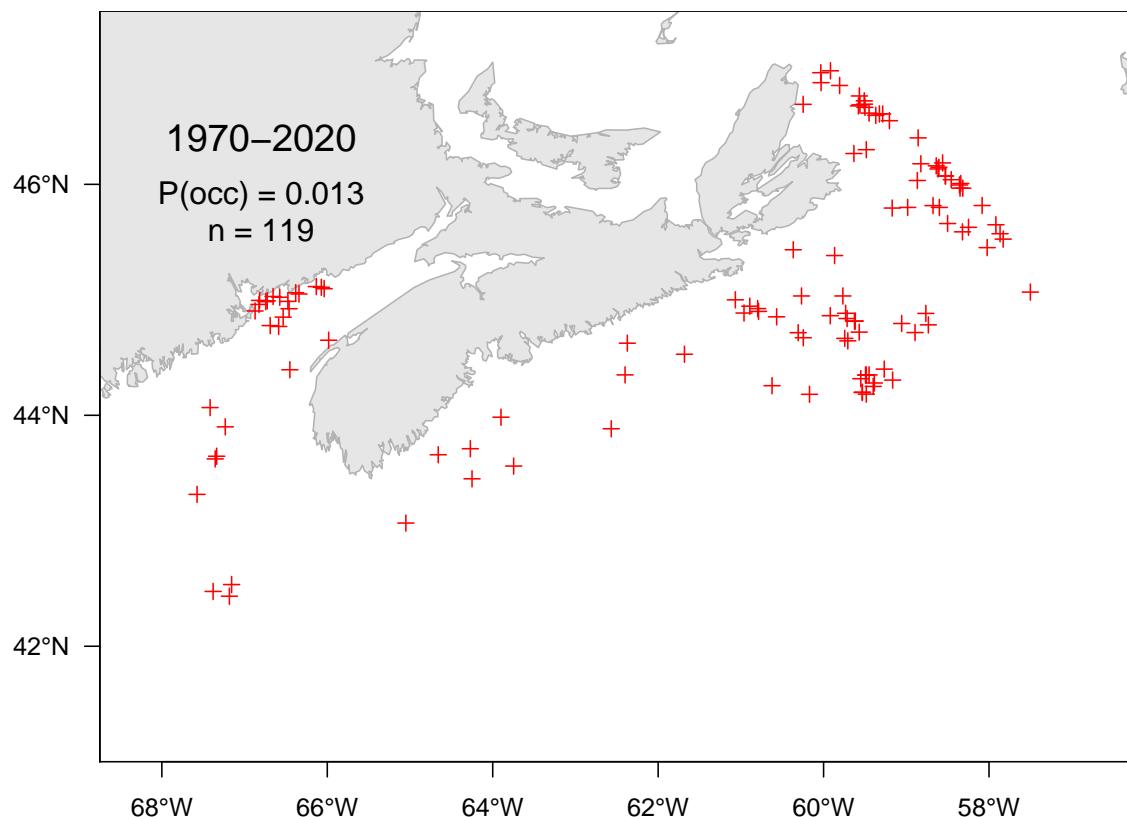


Figure 7.86A. Catch distribution for Wrymouth.

1170

7.87 Spotfin dragonet (Dragonnet tacheté) - species code 637 (category LR)

1171

Scientific name: [Foetorepus agassizii](#)

1172

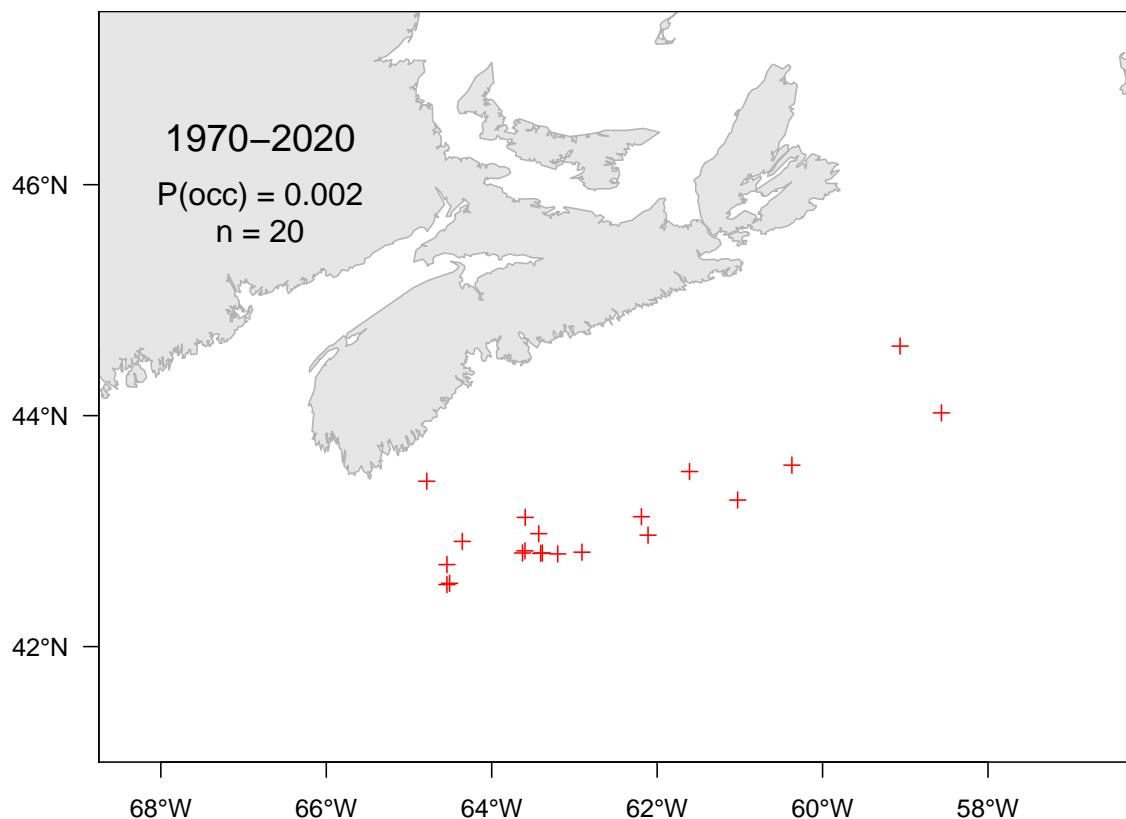


Figure 7.87A. Catch distribution for Spotfin dragonet.

1173

7.88 Arctic eelpout (*Lycodes arctique*) - species code 641 (category LR)

1174

Scientific name: [Lycodes reticulatus](#)

1175

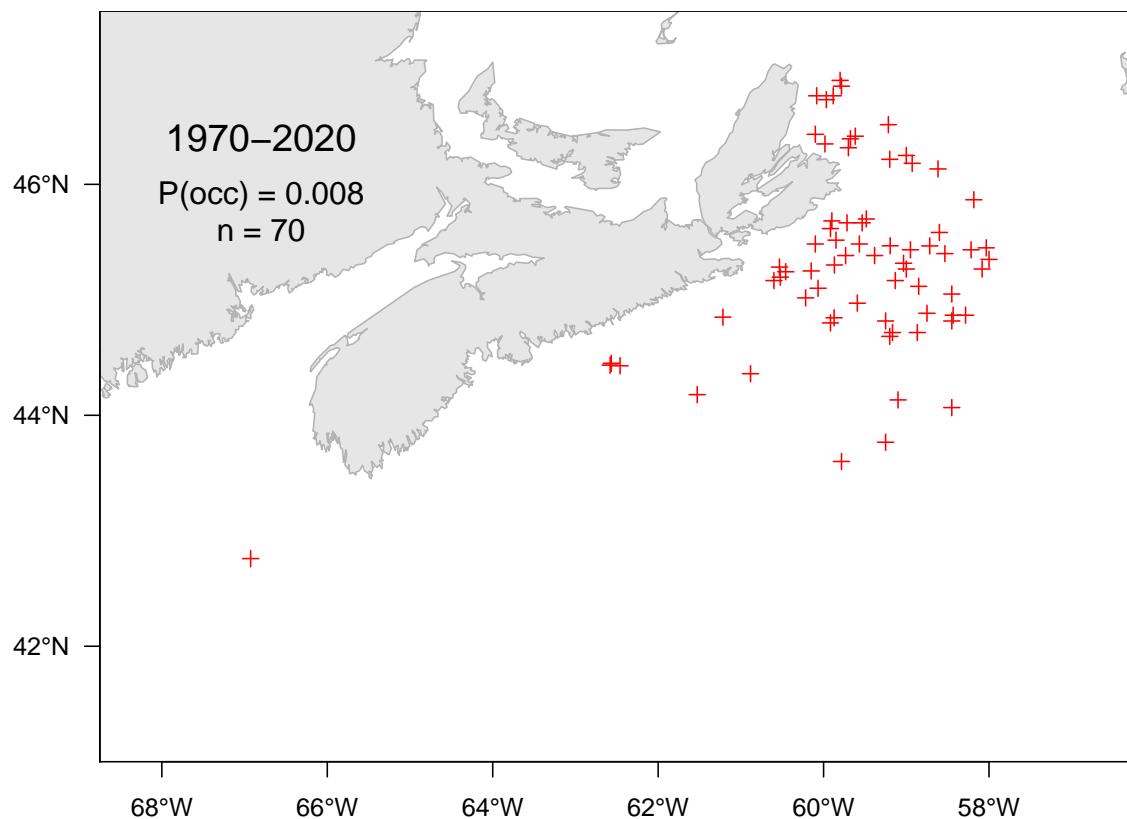


Figure 7.88A. Catch distribution for Arctic eelpout.

1176

7.89 Atlantic soft pout (*Molasse atlantique*) - species code 646 (category LR)

1177

Scientific name: [Melanostigma atlanticum](#)

1178

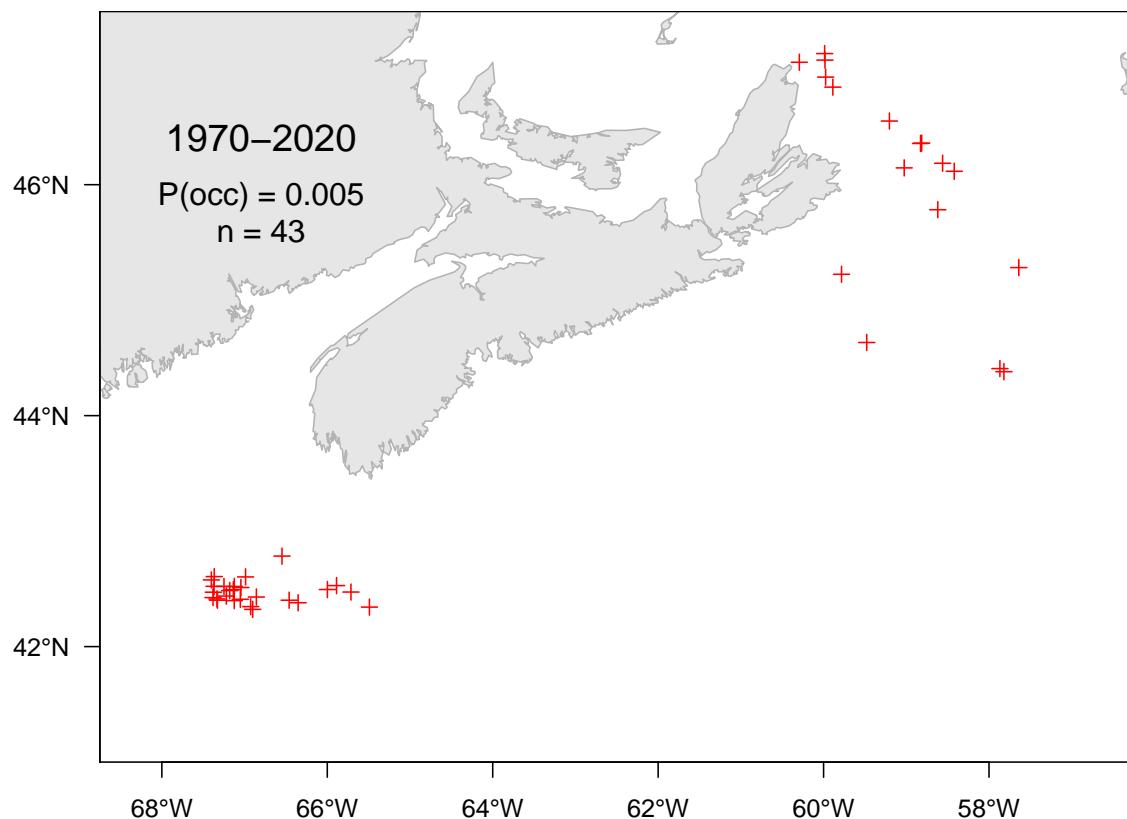


Figure 7.89A. Catch distribution for Atlantic soft pout.

1179

7.90 Rainbow smelt (Éperlan arc-en-ciel) - species code 63 (category LR)

1180

Scientific name: [Osmerus mordax](#)

1181

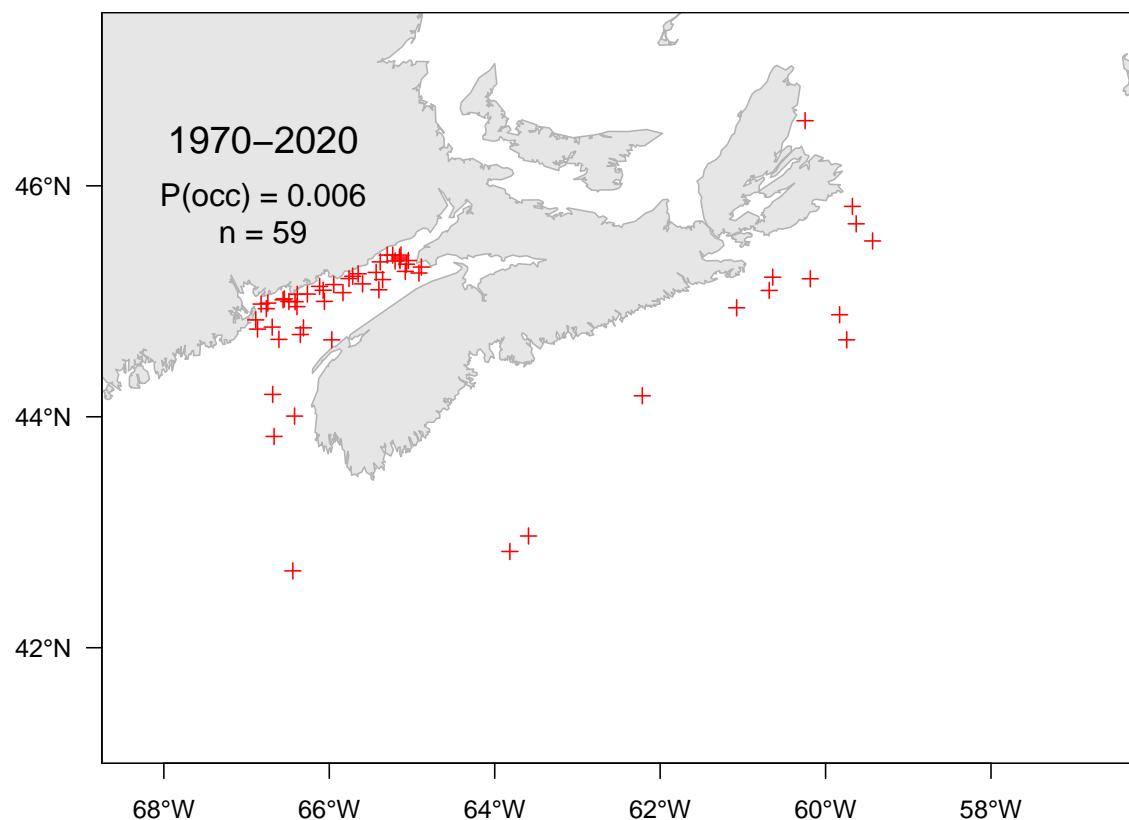


Figure 7.90A. Catch distribution for Rainbow smelt.

1182

7.91 Longnose greeneye (Oeil-vert à long nez) - species code 149 (category LR)

1183

Scientific name: [Parasudis triculenta](#)

1184

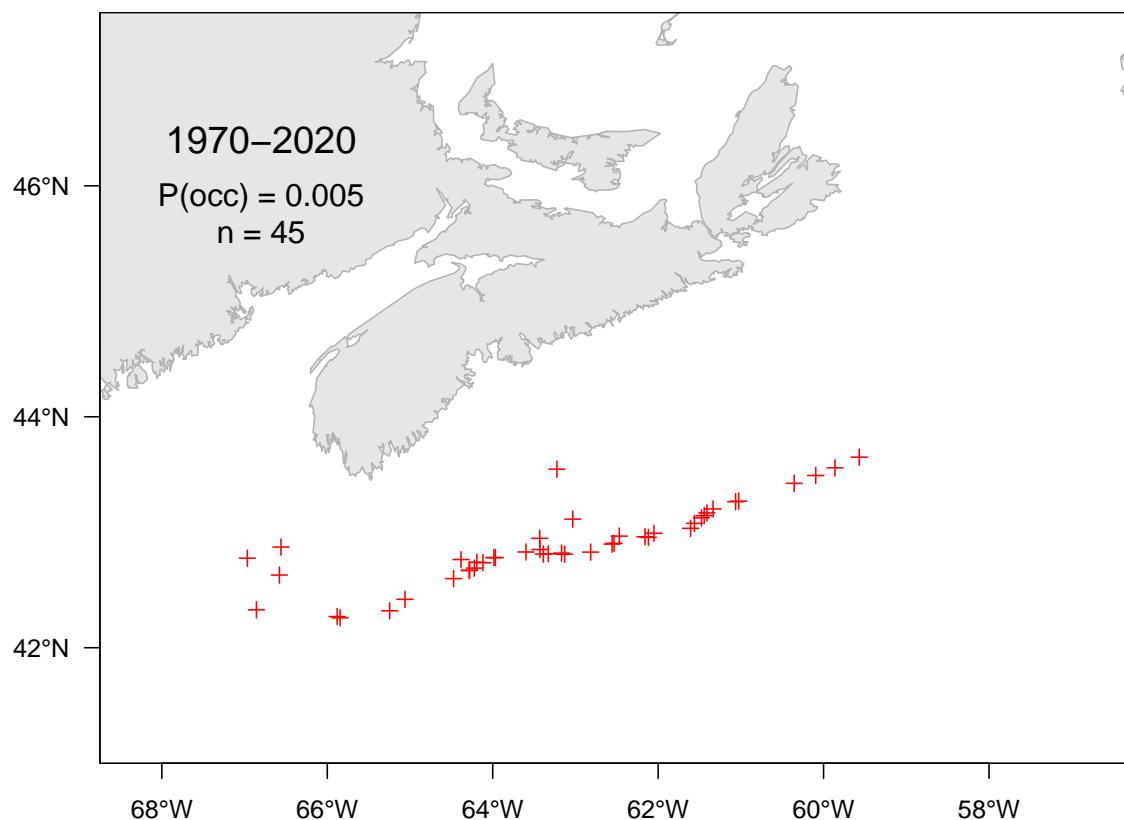


Figure 7.91A. Catch distribution for Longnose greeneye.

1185

7.92 Shortnose greeneye (Éperlan du large) - species code 156 (category LR)

1186

Scientific name: [Chlorophthalmus agassizi](#)

1187

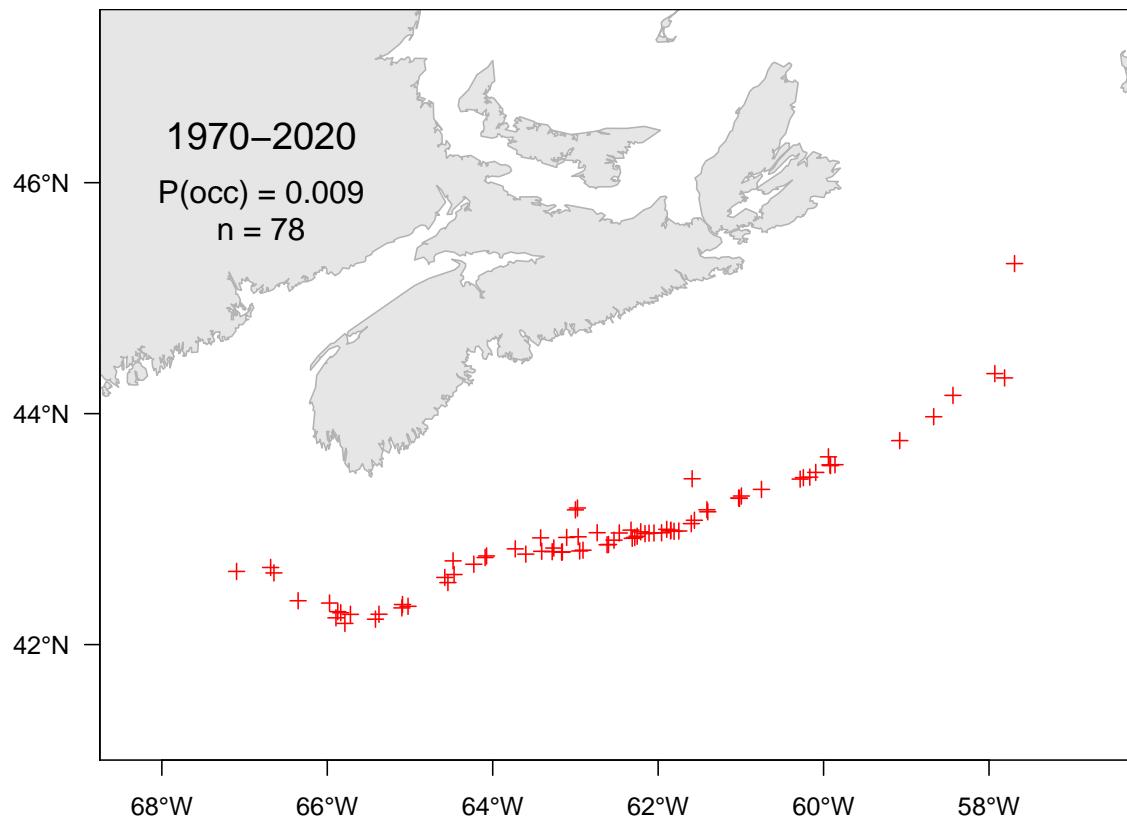


Figure 7.92A. Catch distribution for Shortnose greeneye.

1188

7.93 White barracudina (*Lussion blanc*) - species code 712 (category LR)

1189

Scientific name: [Arctozenus risso](#)

1190

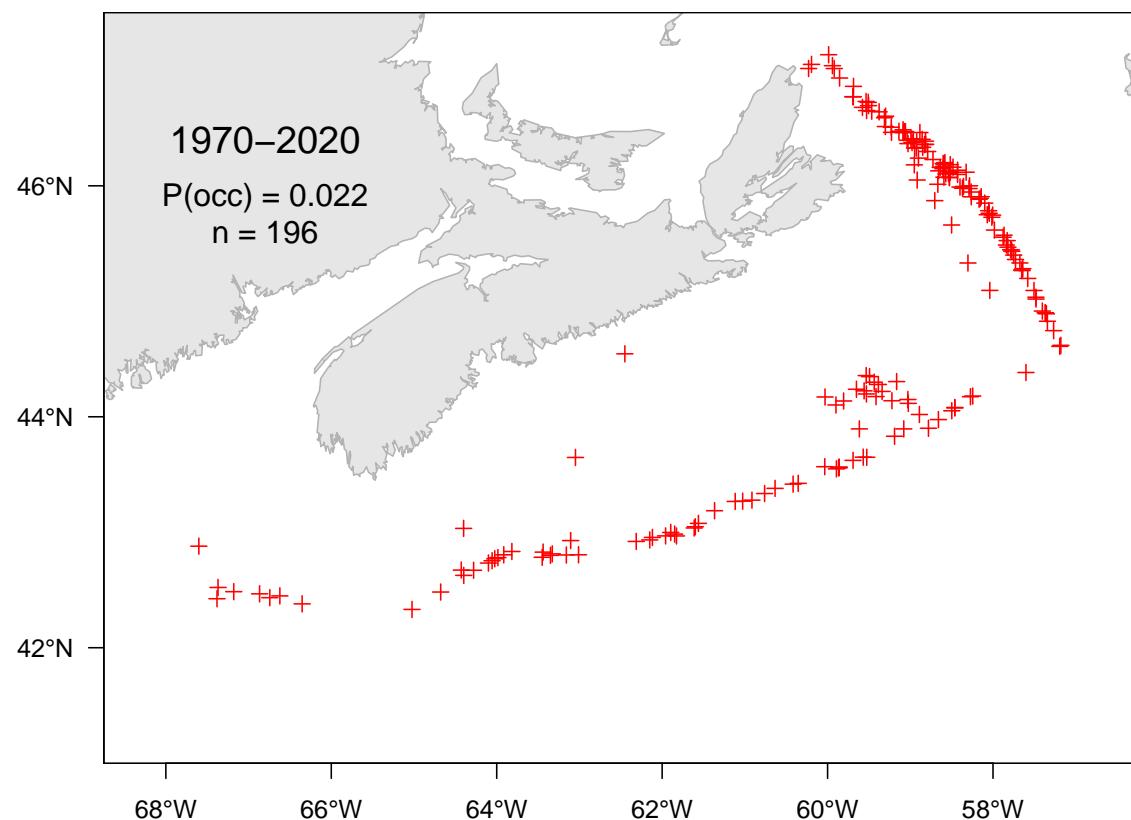


Figure 7.93A. Catch distribution for White barracudina.

1191

7.94 Lanternfishes (Poissons-lanternes) - species code 150 (category LR)

1192

Scientific name: [Myctophidae](#)

1193

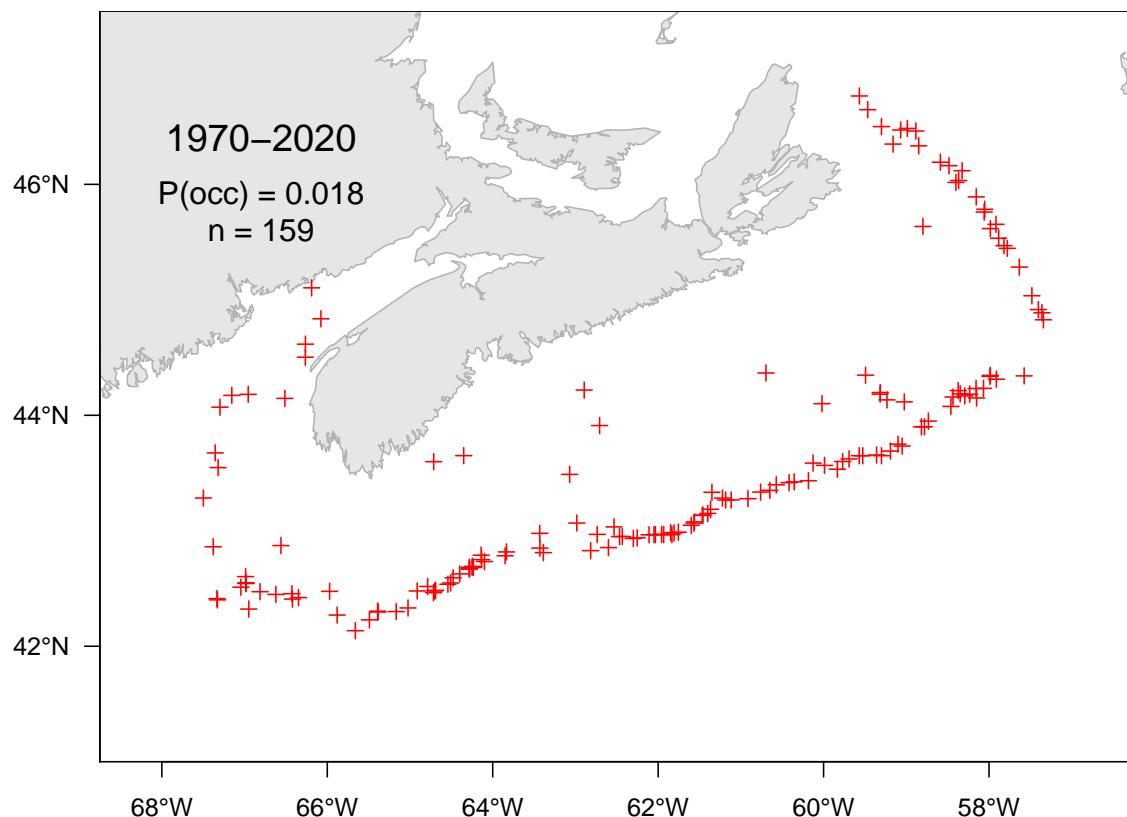


Figure 7.94A. Catch distribution for Lanternfishes.

1194

7.95 Silvery lightfish (Brossé améthyste) - species code 158 (category LR)

1195

Scientific name: [Maurolicus muelleri](#)

1196

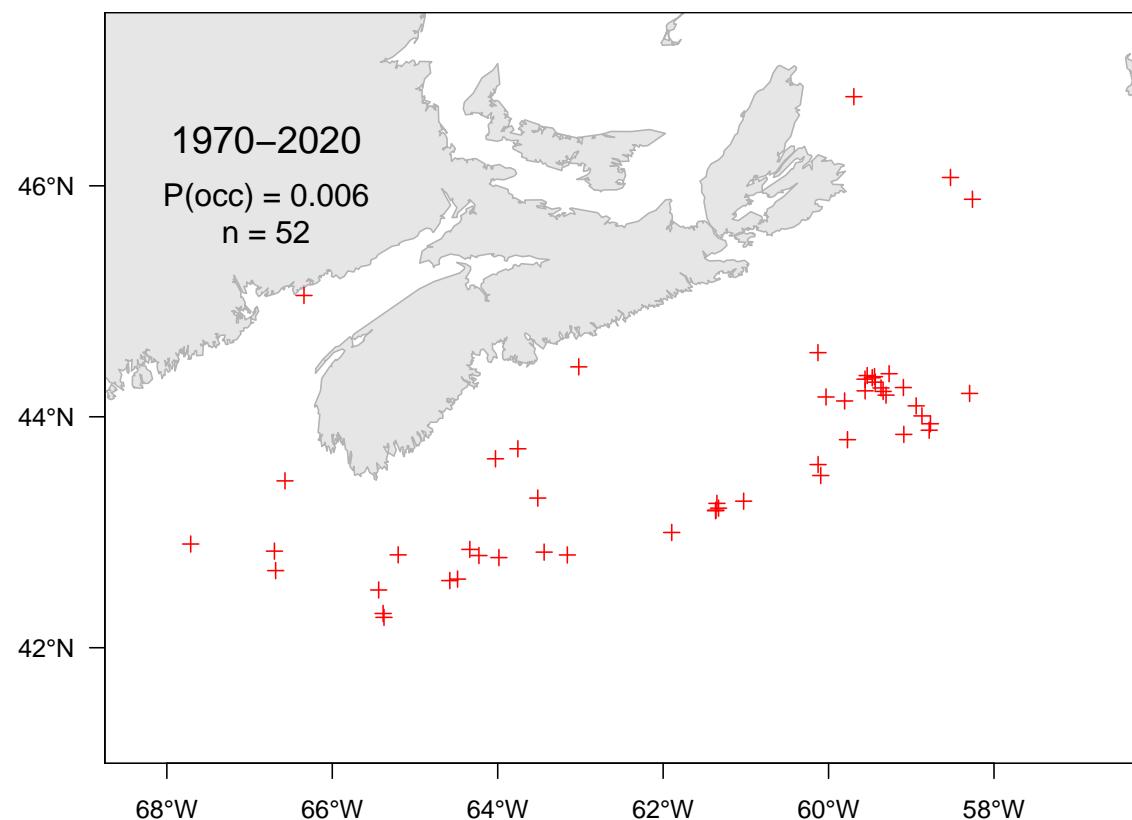


Figure 7.95A. Catch distribution for Silvery lightfish.

1197

7.96 Boa dragonfish (Dragon-boa) - species code 159 (category LR)

1198

Scientific name: *Stomias boa*

1199

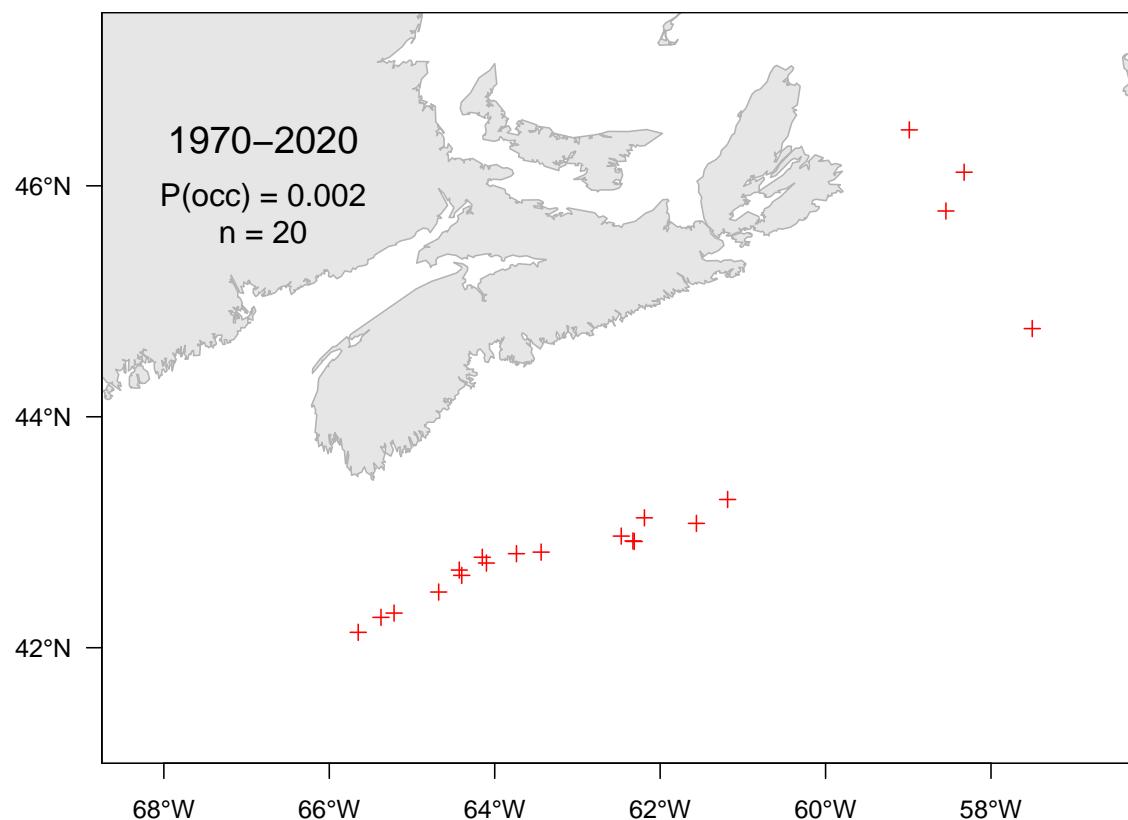


Figure 7.96A. Catch distribution for Boa dragonfish.

1200

7.97 Hatchetfishes (Haches d'argent) - species code 741 (category LR)

1201

Scientific name: [Sternopychidae](#)

1202

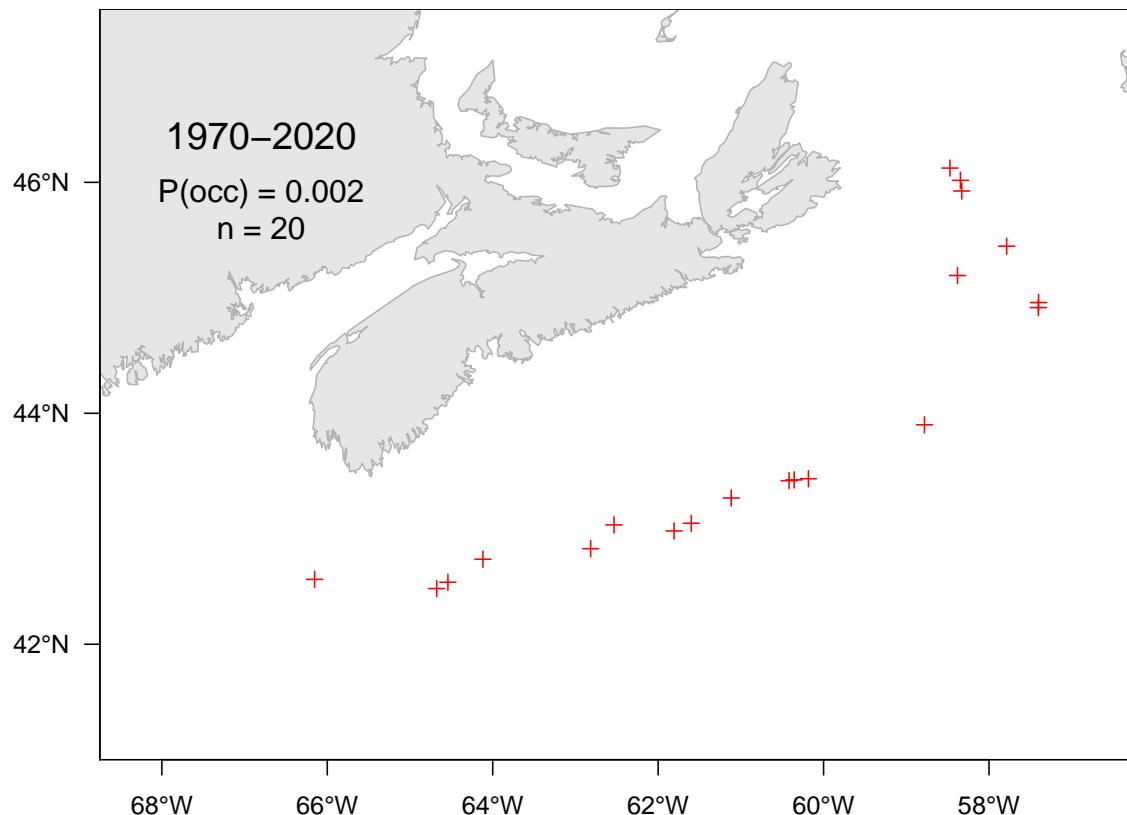


Figure 7.97A. Catch distribution for Hatchetfishes.

1203

7.98 Atlantic batfish (*Malthe atlantique*) - species code 742 (category LR)

1204

Scientific name: [Dibranchus atlanticus](#)

1205

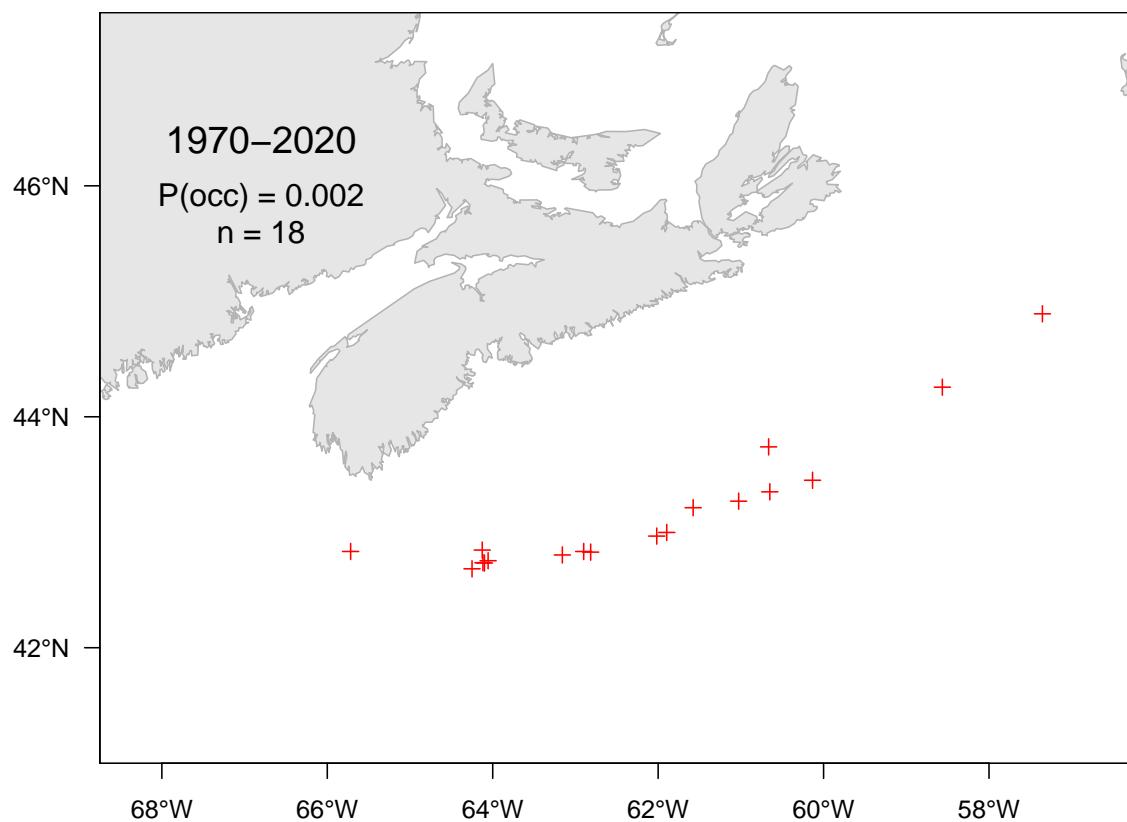


Figure 7.98A. Catch distribution for Atlantic batfish.

1206

7.99 Slender snipe eel (*Avocette ruban*) - species code 604 (category LR)

1207

Scientific name: [Nemichthys scolopaceus](#)

1208

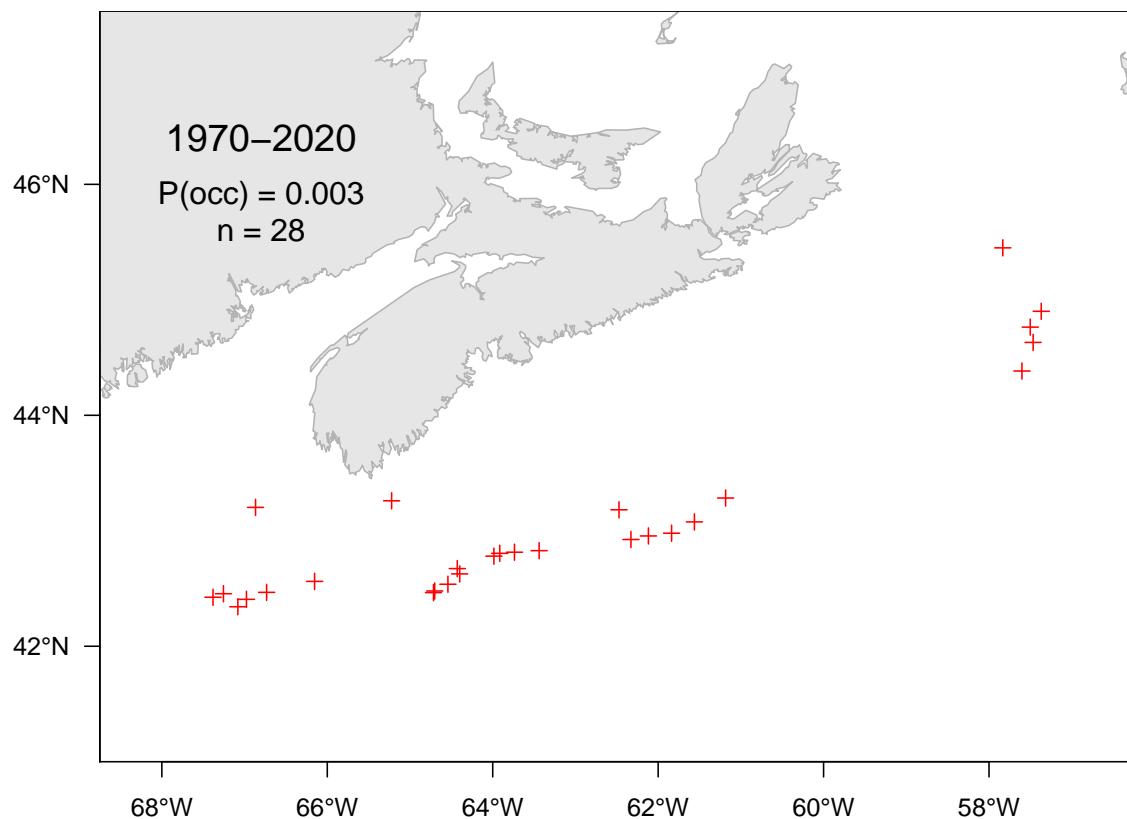


Figure 7.99A. Catch distribution for Slender snipe eel.

1209 7.100 Silvery John dory (Saint Pierre argenté) - species code 704 (category LR)

1210 Scientific name: [Zenopsis conchifer](#)

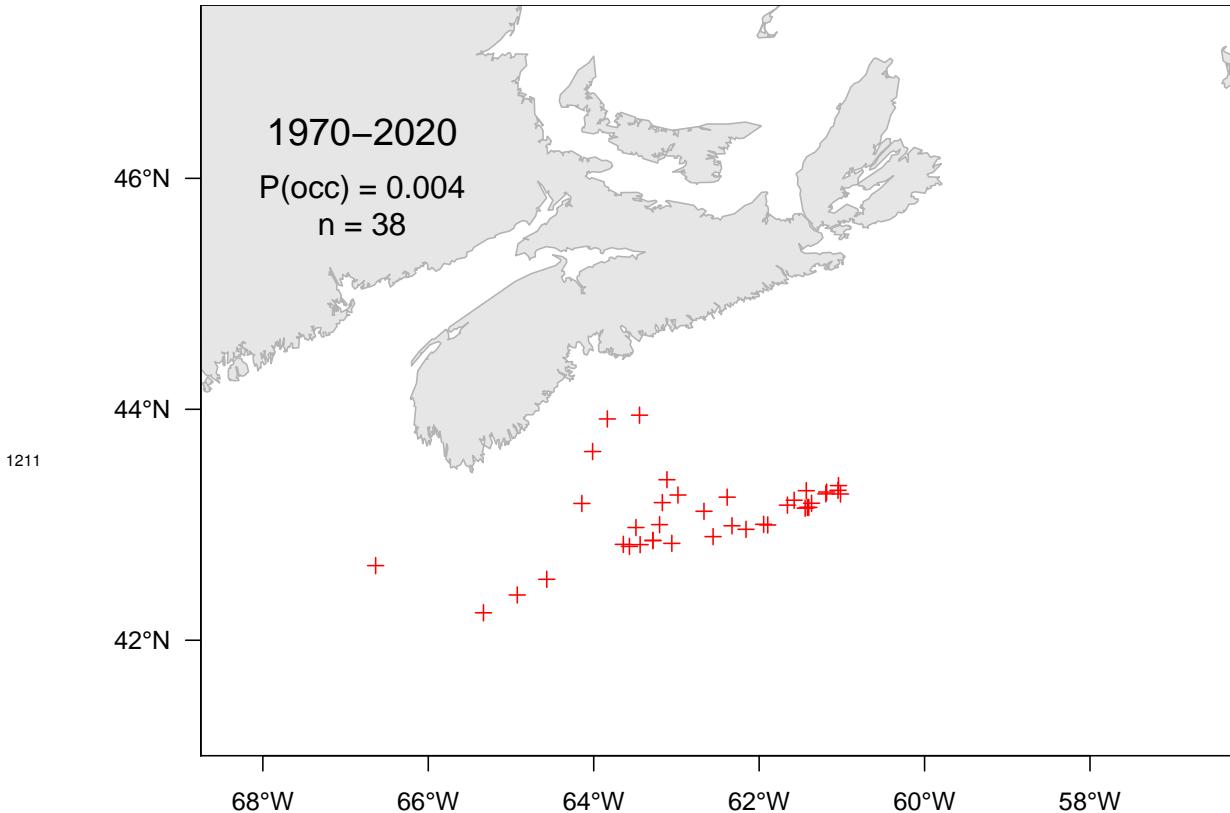


Figure 7.100A. Catch distribution for Silvery John dory.

1212

7.101 Atlantic saury (*Balaou atlantique*) - species code 720 (category LR)

1213

Scientific name: [Scomberesox saurus](#)

1214

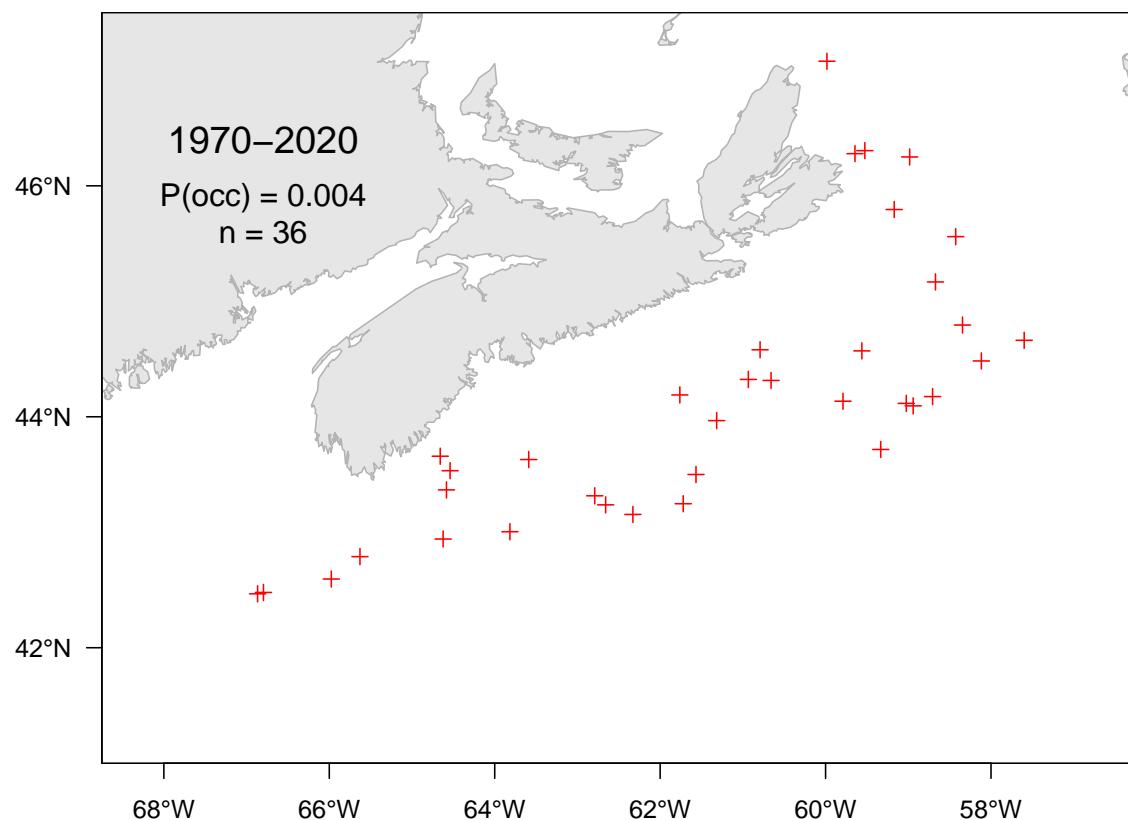


Figure 7.101A. Catch distribution for Atlantic saury.

1215

7.102 Black dogfish (Aiguillat noir) - species code 221 (category LR)

1216

Scientific name: [Centroscyllium fabricii](#)

1217

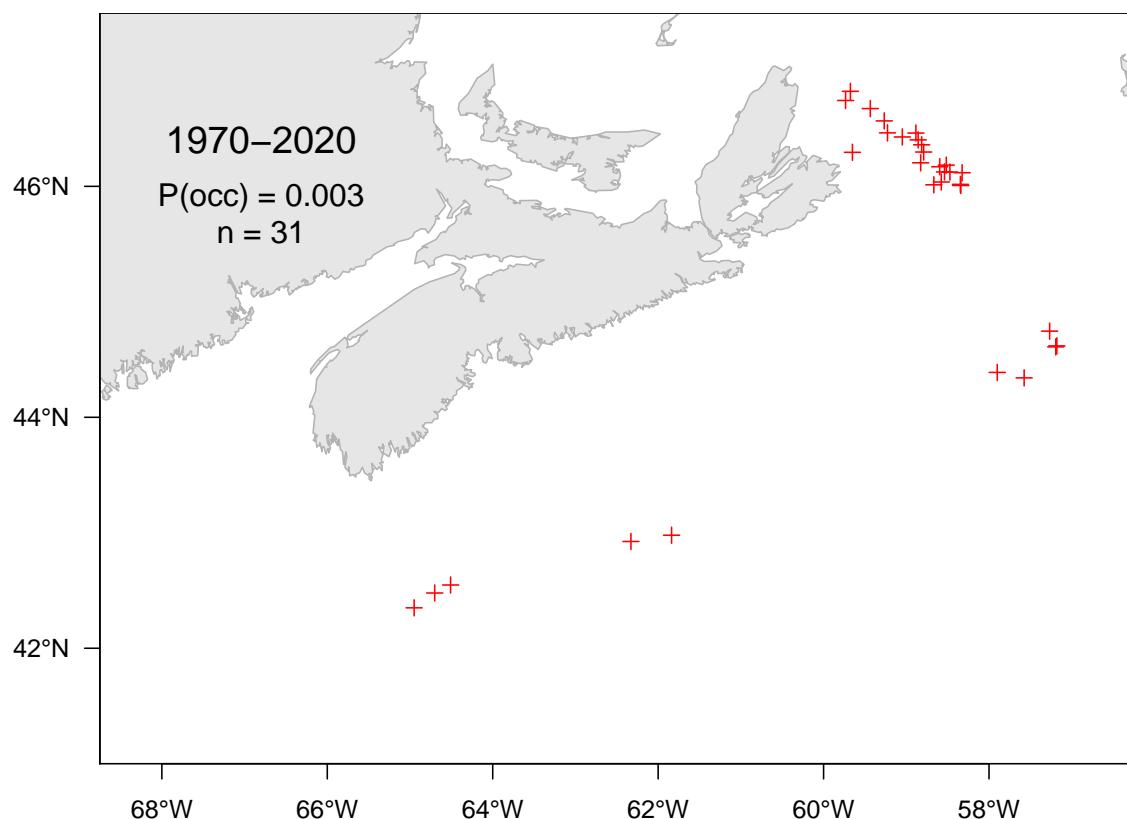


Figure 7.102A. Catch distribution for Black dogfish.

1218

7.103 Longfin inshore squid (*Calmar totam*) - species code 4512 (category LR)

1219

Scientific name: [Doryteuthis pealeii](#)

1220

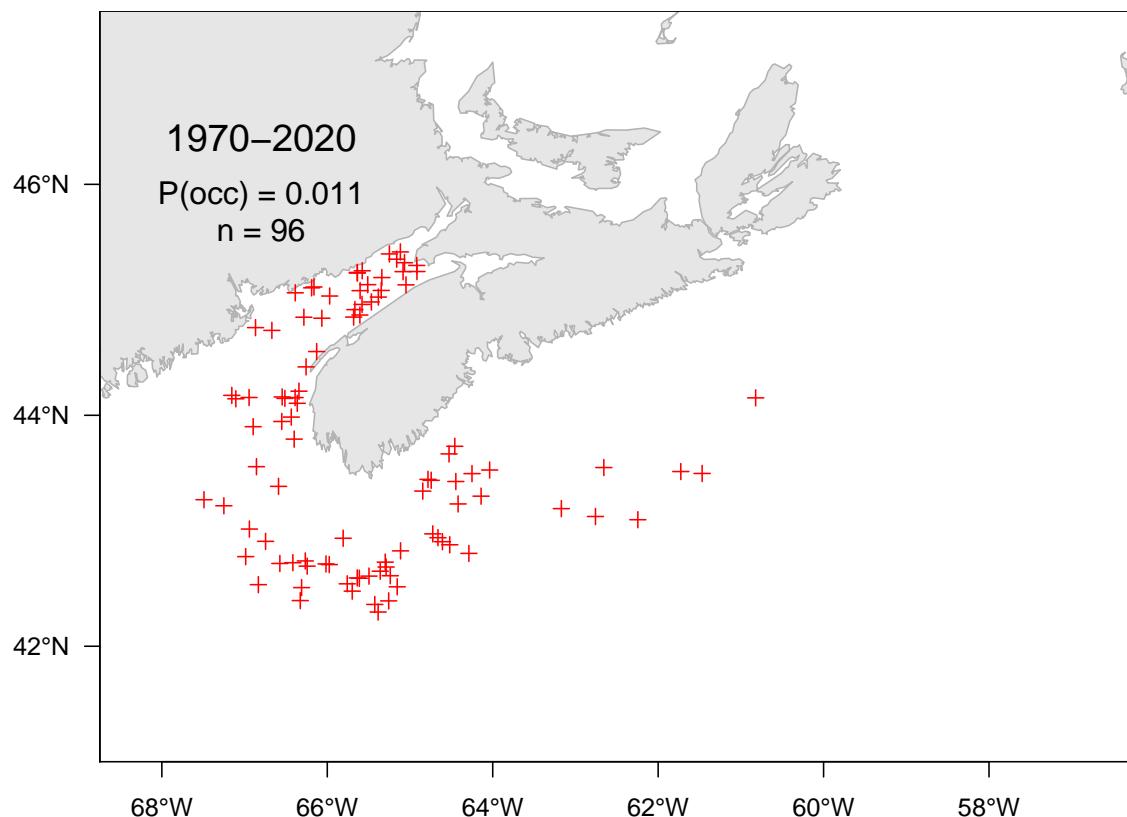


Figure 7.103A. Catch distribution for Longfin inshore squid.

1221

7.104 Red deepsea crab (Crabe rouge) - species code 2532 (category SR)

1222

Scientific name: [Chaceon quinquedens](#)

1223

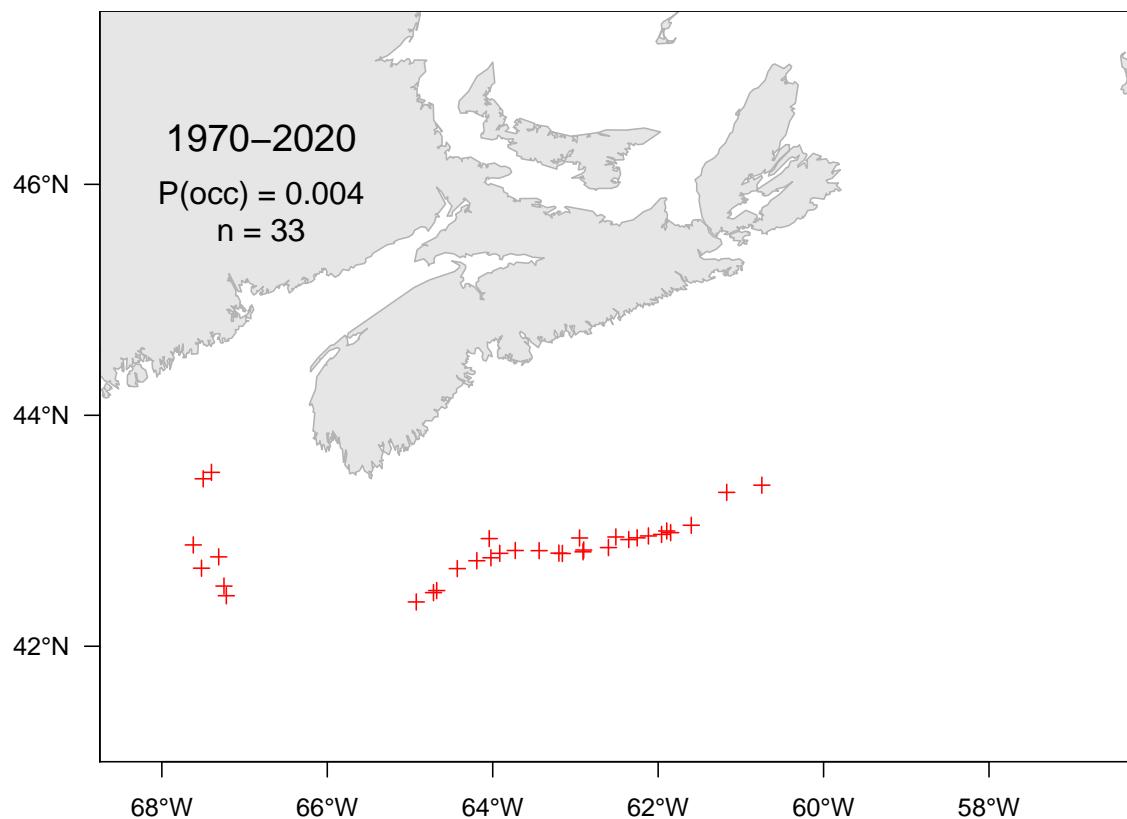


Figure 7.104A. Catch distribution for Red deepsea crab.

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